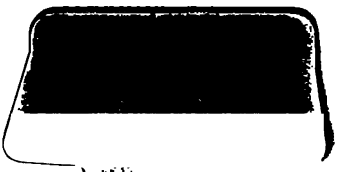
# HARRY LOBB
# ON
# GALVANISM.



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# THE NERVOUS SYSTEM

WITH

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TO

SIR CHARLES LOCOCK, BART. M.D.

THE FOLLOWING PAGES

ARE CORDIALLY DEDICATED BY

THE AUTHOR,

AS A TESTIMONY OF THE VALUABLE ASSISTANCE

AFFORDED BY HIM

IN THE ESTABLISHMENT OF

GALVANISM

AS A *RECOGNISED* AGENT IN THE

TREATMENT OF DISEASE.

## PREFACE TO THE SECOND EDITION.

THE First Edition, consisting of 2,000 copies, having been exhausted in so short a time, proves that there is a desire to receive instruction in the administration of Galvanism and Electro-Magnetism in the treatment of disease. And from numerous private letters which I have received requesting further information on certain points not touched upon in the First Edition, I feel that a more extended course will be received with favour by those who are interested in Electricity as a Therapeutic agent.

As to the plan of the work, I have endeavoured to make it as practical as possible; for the few pages of hypothesis at the commencement I must claim the indulgence of my readers, for I believe I have nowhere else mounted my hobby, and a little horse exercise is good for mental as well as bodily vigour.

To Sir Charles Locock I am deeply grateful, for the assistance afforded me in promulgating my views, as well as for the kindness in allowing these pages to be dedicated to him.

In conclusion, let me bear tribute to the labours of others in this field—De la Rive, Duchenne, Remak, A. Becquerel, Lawrance, Hiffelsheim, and Janin, besides many who devote themselves to the Physiological effects of Galvanism, as Matteucci and Dubois Reymond, deserve the best thanks of all who hope great things from Electricity.

70, Brook Street, Hanover Square,
*September*, 1859.

UPON THE

# ADMINISTRATION OF GALVANISM

AND

# ELECTRO-MAGNETISM.

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THE difficulties which galvanism, as a therapeutic agent, has had to contend with are not a few; the chief being, that the theory of its application and administration has not been clearly defined upon true physiological reasoning; and the apparatus which has been supplied to the profession has been clumsy, inefficient, and unmanageable. These objections have been removed, and I trust in the following pages to be able to prove, not only that galvanism is theoretically the most powerful agent we possess for the cure of many diseases, but that, through the great improvements lately effected in the apparatus for its administration, it is also practically so.

Galvanism is electricity generated during chemical decomposition, and is a force which has hitherto been locked up

within the ingredients from which it is now set free. The amount of electricity liberated depends upon the quantity of chemical decomposition, and, as this is a comparatively gradual and slow process, the electricity, although constant, is of a low degree of tension; that is to say, the atoms of electricity are divided and separated from one another, whereas in static electricity the atoms are in a much more compressed condition and have far more energy. Electricity is one of the great forces which rule the universe, if not THE force, of which all the others are but modifications. Electricity is light, heat, expansion, attraction, probably even gravitation; it is the force which excites the growth of the vegetable world, and is the vitality of the animal creation. The so-called correlation of physical forces (a great step in the simplification of the study of science) is but the various forms taken by electricity in its modifications undergone during its passage through matter; or, in other words, the physical forces are the resultants of the reaction of matter upon electricity. Electricity, active, acts upon matter, passive; the result being a force differing from electricity in its properties, but reconvertible, under certain circumstances, into that agent.

Light, heat, and electricity, what are they? Imponderables. Is coal imponderable? I think not. And coal carbon is but solid light, and may be converted into light, heat, and electricity; and light, heat, and electricity may and have been converted into carbon. The great chemical laboratory of nature for ages, millions of years, collected and stored up

light, carbon, within the tender shoots and leaves, to be dug up by man, to afford him that warmth without which he cannot live.

Light, heat, and electricity may be likened to oxygen, ozone, and the state in which oxygen exists in an oxide,—they are all oxygen, but modified by the condition in which they exist in different states,—thus, ozone is oxygen in an active state, prepared to combine with bases; it is most probable that oxygen, before combining with hydrogen to form water, passes through the stage of ozone—hydrogen must also pass through some similar condition—they then combine, the hitherto repellant atoms are attracted one to another, forming water.

The quantity of matter in the atom of hydrogen is the smallest (as yet) known, and is set down as unity 1; the quantity of matter in the atom of platinum is 99 times that of hydrogen. The self-attractive force in the atoms of matter is in the same ratio as their quantity is minute; consequently, the atom of hydrogen has the most powerful attractive force within itself. It may be now understood, as the atomic attractive force in hydrogen so far exceeds that in platinum, how great must be the attractive force within themselves of the atoms of the so-called imponderables. Davy says, that "if matter should exist as much lighter than hydrogen, as that is lighter than platinum, its actual density could not be ascertained by our present means." Granted; but that does not mean that there will not a man arise

who will weigh even the present imponderables. The great Newton believed that light is material; and if the atoms composing it be intensely small, and their internal attractive force intensely strong, this view is quite practicable. But to return. Platinum, hydrogen, light. Platinum, the atoms of which are large and heavy; hydrogen, the atoms of which are minute and the lightest weighed; light, of which the atoms are (hypothetically) intensely small and light; but however small an atom may be, and however far apart the atoms may exist, still it is possible to compress those particles so as to produce a solid; this has been done in the instance of carbonic acid gas, where it has been solidified by pressure. Now if what I believe to be the fact be true, that carbon is the result of the atoms of light so brought together and compressed as to become a solid, here we have a stage of the process which much simplifies the argument, because carbonic acid gas is to the unscientific mind imponderable; and, in fact, it is but a very few years since by all it was considered imponderable; therefore, if this gas can by pressure be converted into a solid, by a little further stretch of the reasoning faculties, light might also be weighed, measured, and solidified.

That light is material and may be absorbed and exhaled, has been proved lately by some most interesting photographic investigations, in which engravings, having been exposed to a bright solar light, have been removed to a darkened room, and there photographed from the light which they had pre-

viously absorbed and are now exhaling; this is the test experiment proving the materialism of light, and that it is a positive force in our world; and that it is not a mere result of the undulations of ether, but matter, and nothing but matter, most minutely divided, beyond human ability to condense and handle, is true, but material for all that.

Is light *the* force? I believe not; merely a modification of it, a correlation. Is heat? Certainly not. Is electricity? Not as we know it, and experiment with it; but as it exists in the sun, the spheres, space, and in our system generally—yes.

Light, heat, and electricity—three conditions of the same force; they can be converted into one another, and it is the effects produced upon them in their passage through matter, which makes the difference men of science have recognised. Forces! there is but one force, which in its travels takes many shapes to different observers; it passes in and out, up and down, always changing, and apparently disappearing, but never lost. Force cannot be lost; it acts and reacts, it lies dormant and locked up for centuries, but there it is, some day to reappear, resistless, triumphant.

The idea I wish to convey is, that electricity, one of the embodiments of *the* force, is convertible, under certain conditions, into every other force; and that, according to its application, it may be made use of to any purpose in which a force is necessary. Thus, suppose heat be required, electricity may be converted into heat with the greatest ease. Suppose we

want light, the brilliancy of the electric light is proverbial. If we wish for mechanical force, electricity passing round a piece of soft iron, and we have it at once. If we want a stimulus to organic force, what so powerful as electricity? Will it not stimulate the growth of plants? can we not cause the muscles of the dead to contract; cause the nerves to perform their functions after death, even to digestion; lend health to the diseased, and life to the dying? Thus, then, we have in electricity a grand and universal panacea; the method of application being the great desideratum.

It will be my endeavour in the following pages, to elucidate to the best of my ability those methods which I have found most applicable to the different affections to which it has been at present adapted; at the same time, I may state with confidence, that what has been done, although much, is as nothing to what the agent is capable of. Electricity is convertible into nerve force; this fact alone holds out a promise of the most magnificent triumphs to those who will adapt it to medical purposes. No one man can hope to master the subject; it will require the joint labours of many an earnest student of nature, before electricity takes the place as a therapeutic agent which its merits will eventually claim for it.

## General Laws of Electricity.

Electricity is derived from the Greek ἤλεκτρον, amber, because the ancients observed that by the friction of amber a power of attraction was generated within it. This force

is termed electricity. It exists in all matter, either latent and unperceived, or free and demonstrable. There are many methods of inducing the presence of this force from matter in which it may be latent; and according to the material from which it is evolved, and from the means we take to free it, so do the phenomena of its presence vary. The effects produced by its action upon matter, are *mechanical, luminous, calorific, chemical, magnetic,* and *physiological,* —and it is with the latter we chiefly have to deal.

If a piece of amber be rubbed upon the coat-sleeve and placed near some light bodies, as pieces of blotting-paper, the latter will be attracted to the amber, and will stick to it for a time.

What takes place? The friction of the amber disturbs the electrical equilibrium which had hitherto existed within it; its electricity has become dynamic, and it readily parts with it to surrounding bodies. Attraction takes place; but, when the equilibrium has been again defined, there is no longer any attraction, and they fall away.

There is another condition in which bodies in a state of electrical excitement repel one another; namely, when they are both in the same condition of excitement. Suppose we have two pieces of amber rubbed upon the sleeve, although they both separately attract the pieces of paper, they repel each other.

This state of attraction and repulsion is the essence of electricity; it is the different states of capacity in which

matter exists. Heterogeneous bodies which are in opposite states of capacity attract each other. Homogeneous bodies which are in like states of capacity repel each other.

Capacity is that condition of matter in which it is or is not enabled to receive the force applied to it. All matter is composed of hypothetical atoms, between which an elastic fluid or ether permeates. This elastic fluid has the power of absorbing or giving off the force applied to it; this is termed its capacity.

Thus: One portion of matter has absorbed within itself as much of a force as it is capable; another portion has none. They come within a distance that the portion of matter which has the force is enabled to impart it to the other; here we have attraction: but when they are both equally full they fall away, and repulsion takes place.

We can now easily understand what is conduction and a conductor. A conductor is matter whose component atoms are so arranged as easily to impart from one to another the force applied to any portion of them. A conductor, therefore, must have its component atoms arranged closely, and they must be all as nearly as possible of the same capacity. Thus, metal is a good conductor, the atoms are all alike, and they are closely packed. Glass is a bad conductor, it is formed of many atoms of different capacities. Wood is a bad conductor, formed of various atoms of very different capacities, and not closely packed. The air is a bad conductor, it is not closely packed; moistened air is better, it is more

closely packed; water is still better, the component atoms being still closer.

Conduction leads us to another important property of electricity, namely, *induction*, which is the power electrified matter has of inducing an opposite state in other conducting matter, which, although separated from it, is within a certain distance. Thus, if we imbue a disk or ball of metal with electricity and place it near a disk or ball separated by a thin layer of a non-conducting medium, the second disk, by *induction*, is found to be in an opposite electrical condition to the former.

### Electrical Repulsion demonstrated by the Electroscope.

Hold in the right hand the negative extremity of an excited Pulvermacher chain of twenty elements, and let the free positive end touch the upper movable plate of the electroscope. Now touch the under plate with the other hand, and at the same moment remove the upper plate by the glass handle and the lower hand. The gold leaves will immediately diverge from one another; the reason for which is, that the gold leaves being both positively electrified by the current from the chain, spring asunder when the chain is removed. If the air beneath the glass be quite dry, they will remain in this divergent condition some time, the electricity slowly flying off. If, however, the air is moist, the electricity is more or less quickly conducted away by the moisture.

How is electricity conducted through a fluid? By *electrolysis.* And it is by the complete comprehension of electrolysis that the laws of electricity and galvanism can be best understood; and I shall now describe the galvanic battery, which will enable the reader to at once grasp the great electrical law.

THE ELECTROSCOPE.

Galvanic electricity is commonly derived during the combination of zinc with the oxygen of water and sulphuric acid. Zinc, a metal, is electro-positive to sulphuric acid; they are consequently in a condition to combine. In other words, the two are in opposite states of capacity, and are prepared for equilibrium. When the zinc is placed in the diluted acid, water is decomposed, its oxygen unites with the zinc and sulphuric acid, forming sulphate of zinc, and the hydrogen escapes; electricity, the agent which retained the oxygen and hydrogen in conjunction, is liberated. This process goes on for a time, but soon it becomes slower and slower, until the combination of the zinc and acid altogether ceases. If a less oxidizable metal, a metal whose capacity is not so opposed to the acid as the zinc, be inserted in the fluid, and joined at the upper part by a good conductor—say a plate of copper, joined by a copper

wire — the formation of sulphate of zinc proceeds with renewed energy.

The new metal alters the whole state of things. The acid which was electro-negative in reference to the zinc is electro-positive in reference to the copper, by induction, and yields to the negative metal the liberated electricity; this flows round by the conducting wire, and is returned to the zinc, and the whole process goes on rapidly, until the zinc is gradually reduced to its sulphate, and the acid is exhausted.

Theoretically, it is supposed that the ultimate atoms of the fluid in which the metals are inserted act in parallel directions one upon another: that the surface of the atom in contact with the zinc is negative, its opposite surface positive; the surface of the next atom negative, and so on. Although, therefore, the electricity generated may appear continuous, it is in reality a series of interrupted actions, almost inappreciable portions of time intervening between its conduction from one atom to another, so that the (so-called) galvanic current is a series of electric vibrations flowing in a stream, which, from the immeasurable portions of time intervening between each vibration, may be considered for all practical purposes as continuous.

This, then, is the galvanic battery. It is an apparatus by which we are enabled to extract the force which overcomes the repulsion usually existing between the atoms of the gases composing water, to collect that force in a continuous

stream, and to make it useful for the purposes of the arts, treatment of disease, &c.

The quantity of electricity generated is dependent upon the surface of the zinc to be acted upon by the acid. Electricity thus generated is of so low a tension (it does not concentrate its component atoms, so as to be able to pass through anything but a conducting medium) that it would be of no use as a therapeutic agent, except for action merely upon the surface, as in the case of an ulcer; but it has been discovered that the tension of the fluid increases in the same ratio as the number of systems, or separate batteries; so that by uniting the negative pole of one battery with the positive of the next, and so on, we have a continued stream of galvanic electricity in a uniform direction, and of any required tension; but if we employ the usual batteries,—such as Grove's, Smee's, or Daniell's,—the number required, and their size, would be an insurmountable obstacle to their use.

### Apparatus for the Production of the Galvanic Current.

The surface of zinc submitted to the action of the acid for the purpose required, however, is so small that there is no need for the larger batteries. This fact has been seized upon most ingeniously by M. Pulvermacher, who has devised a series of batteries which, by their number, generate electricity of high tension, and yet, from the smallness of surface of

metal excited, in no great quantity; so that we have electricity of sufficient tension, without the great heat and chemical power of the large batteries. To effect this, thin zinc wire is wound round a small wooden rod; one end of the wire entering the wood, the other terminating in a loop; at the opposite end to the zinc loop there is a loop of thinner copper wire, which winds round the rod in the interspaces of the zinc wire, and pierces the wood at the opposite end. We have here, therefore, a perfect miniature galvanic battery with a positive and negative pole.

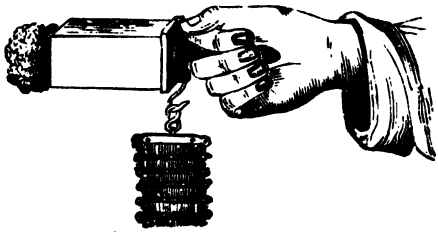
When excited by an acid, sufficient electricity is generated to deflect the galvanometer to its extreme limit; by attaching the positive pole of the one to the negative of the next, and so on, a chain is formed of any number of minute batteries, which, when excited, gives out electricity of high tension, and in sufficient quantity for almost any medical purpose.

This arrangement M. Pulvermacher has termed the hydro-electric chain, and I make use of it where I require a continuous current of electricity in a uniform direction, and

TWO LINKS OF PULVERMACHER'S HYDRO-ELECTRIC CHAIN.
*Being Fig. 434 from De la Rive's Treatise on Electricity.*

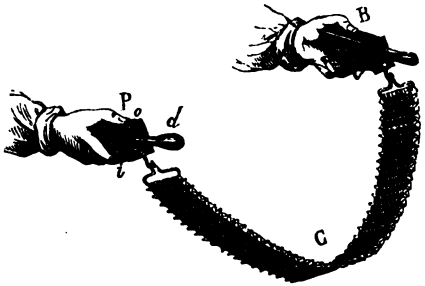
known tension. The chain battery is easily excited by diluted vinegar, and yields a steady current of electricity.

Six links of this battery produce sufficient galvanic electricity to decompose water into its component gases. For



THE ELECTRO-PHYSIOLOGICAL MODIFICATOR
*Fig* 438, *De la Rive's Treatise.*

producing the interrupted current, M. Pulvermacher has invented a little instrument which is set in motion by clock-




G. The Hydro-Electric chain Battery.
P. The Electro-Physiological Modificator.
B. A Conductor, with moistened Sponge.

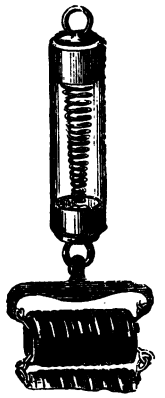
work, and which he terms the Electro-Physiological Modificator, having the power of interrupting and renewing

the current at the will of the operator, or producing rapid vibrations.

The chain battery may be attached to this apparatus, and used for the stimulation of muscles locally.

The interrupter, or interruption cylinder, is a small tube of glass, terminated at each extremity by a copper ring. It contains a spiral spring, movable at one end, so that when it is attached to a chain, or between two chains, by the movement of the body, vibrations are induced in the spring, and an interrupted current of greater intensity and quantity passes.

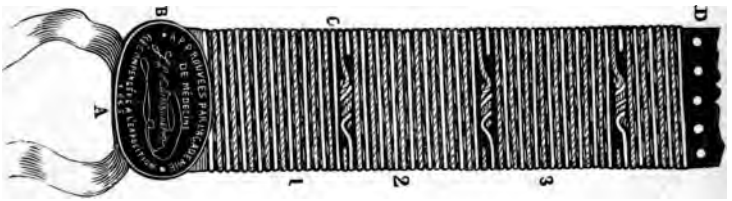
M. Pulvermacher has since improved upon his first invention, and has originated the galvanic band, the properties of which I shall proceed to describe, as I believe it is the most perfect apparatus yet introduced to the notice of the profession. A flat band of gutta-percha is used as the basis on which to wind the wires for the production of the current—wires being used as affording a larger surface than any other form. A zinc and copper wire, at a certain distance, are wound round the gutta-percha band from four to any number of times, according to the quantity of galvanism required, near together, but without touching. The two wires are then twisted together, and the other ends



THE INTERRUPTER.
*Fig. 437, De la Rive's Treatise.*

divided so as to form a separate and distinct element. The same process is repeated so as to form any number of elements.

By this simple apparatus, which can be adapted to any part of the body or limbs, a constant current can always be obtained by first immersing it in vinegar, or vinegar and water, then placing it upon the required part; the perspiration of the body (which is more or less acid, according to the idiosyncrasy of the individual, the state of his secretions, and the weather) will retain a current as long as it may remain in contact. The greatest energy is observed at the zinc or negative pole; this is the alkaline, resolvent, and hydrogen pole, and frequently the skin under the zinc is destroyed, producing a small eschar. These eschars are, however, by no means necessary for the cure; and if observed, the vinegar should be diluted, so as to avoid their production.




THE GALVANIC CHAIN BAND.

In our remedies we should imitate nature as nearly as possible; so that in the application of electricity, a weak sustained current is more likely to effect a cure than, however

energetic it may be, if applied but a short time; this refers more particularly to the continuous current, it being practically impossible to keep a sustained interrupted current for any length of time.

Besides the chain band for general use, M. Pulvermacher has manufactured, at my desire, the bath chain, which is a very powerful apparatus for generating the galvanic current to be used with the bath; and I find it of the greatest possible value as an aid to other treatment in paralysis, &c.

M. Pulvermacher has also contrived for me an apparatus for generating the continuous galvanic current in great intensity. By combining four of the large bath chains together, the negative pole of the first to the positive of the second, and so on, and placing them in a gutta-percha vessel,—so that when it is hanging the chains may be quite free in the air, but upon being tipped up, the acid, which is contained in a trough at the bottom, runs up and excites the chains lying upon the gutta percha,—we have a battery of great energy, portable, easily excited, and constant; great desiderata in the administration of galvanism.

### Apparatus for the Production of the Induced Current; Electro-Magnetic Apparatus.

The next form of apparatus is a modification of the induction coil, introduced by Professor Faraday. The use of the induction wire being to produce electricity of tension out of

electricity of quantity, so that by the aid of the coil apparatus an appreciable spark of electricity may be procured, from that generated by a single galvanic cell.

The apparatus of MM. Legendre et Morin I shall describe here, as it is exceedingly cleverly constructed, and very well suited for general use.

The following is a condensed and free translation of the instructions accompanying the apparatus :—

"To charge the battery.—In the porous vessel pour a little nitric acid, and into the brass one a little pure water, or salt and water; then place on the gutta-percha cover, and put it into the box, the brass arm marked O being turned so as to rest upon the wire of platinum protruded from the gutta-percha top; the repeated vibrations show that the apparatus is at work.

"When the apparatus is not required, the battery should be removed from the box, as the fumes rising from the acid spoil the brass. By lifting the graduator marked 8, the intensity of the current of induction is increased.

"The brass nuts marked ( . ) ( : ) ( ⋮ ) are pierced with holes to receive the conducting wires.

"Upon placing the wires in nuts ( . ) and ( : ) the current of the larger wire passes.

"In nuts ( . ) and ( ⋮ ) the current of the fine wire.

"In nuts ( : ) and ( ⋮ ) the sum of the united currents.

"Nut ( . ) is the positive pole; nut ( ⋮ ) the negative pole.

"Nut ( : ) is negative to nut ( . ) and positive to nut ( ⋮ ).

"The button being turned to the right arrests the intermittences, to the left they are continued; but when the button is turned to the extreme right by a to-and-fro action, the intermittences can be produced at will."

This beautiful little apparatus has many advantages over the ordinary electro-magnetic apparatus, the currents of the different wires being obtained separately. The current of the extra wire of M. Duchenne can be employed, said by him to more actively excite the sensibility and contractility of the muscles, and of some subcutaneous organs.

Upon placing the conducting wires in nuts ( . ) and ( : ), and allowing a continuous current to pass, the needle of the galvanometer is powerfully deflected; upon turning the button, so as to give rise to vibrations, the galvanometer is more powerfully affected than before, but the vibrations are arrested. This current gives rise but to slight painful sensations.

Upon placing the conducting wires in nuts ( . ) and ( ⋮ ), the effect upon the galvanometer is not so great, but the interrupted current has a more stimulant effect upon the nerves of sensation, and upon the muscles.

In nuts ( : ) and ( ⋮ ) the current has still less effect upon the galvanometer, but the nerves of sensation and the muscles are most powerfully stimulated.

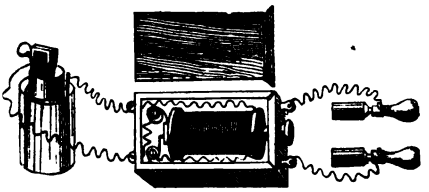
The apparatus of Messrs. Bull and Co. is a close imitation of that of Legendre et Morin, and may be considered equal to it for ordinary purposes. The small apparatus marked No. 1

is, from its regularity of action, peculiarly adapted for administering the interrupted current in Dentistry, and for producing revulsive effects, as in Painters' Colic, as recommended by Briquet. Not having the current of the primary wire, it is not suited to the treatment of muscular paralysis, to which No. 3 is well adapted.

No. 3.

Size—5 inches square, containing the whole.

No. 1.



MESSRS. BULL & CO.'S ELECTRO-MAGNETIC APPARATUS.

Ruhmkorff's portable inductive apparatus is very elegant and complete, and well adapted for medical use. It is extremely portable, being about the size and shape of the ordinary enema case. It is excited by an acid salt of mercury; namely, the proto-sulphate. The action is regular and energetic; it is easily excited and very cleanly; the conductors are contained in the case, as also the proto-sulphate, so that a little water is all that is required to set

it in action: some care, however, is required to keep the brass work, &c. clean.

### Conductors required for the Administration of Galvanism.

There are several forms of conductors required for the administration of galvanism to the different organs.

If we wish to localise the electricity in the skin, it should be thoroughly dried, and dry metallic conductors should be used; if, on the contrary, we wish to penetrate to the internal organs, muscles, or nerves, the skin should be well moistened with salt and water, and the conductors should be moistened sponges. In stimulating a paralysed muscle, a pointed metallic conductor, covered with moistened sponge, should be used, as we are thus enabled to search out any particular muscle and stimulate it individually; this is frequently required also as a method of diagnosis, to discover which muscles are excitable and which not.

Some of the deeper muscles are not easy to get at, and it requires some anatomical knowledge to discover the point where the nerve enters the muscle, upon which spot the conductor should be placed.—(*Remak.*)

For paralysis of sensation of the surface, a wire brush is sometimes required; also for the teeth, or sometimes a single wire to penetrate a decayed tooth. The electric poultice requires a large surface of metal; a piece of thin sheet-silver, brass, copper, or tin, will answer the purpose.

## Comparison of Daniell's Batteries and Pulvermacher's Chains.

The following are the results of several experiments made to compare the relative penetrative and galvanometric effects of a series of thirty Daniell's Batteries and Pulvermacher's Bath Chains.

Upon passing a current through the body from hand to hand, and using the finger as a conductor to decompose water, it took six connected cells of Daniell's arrangement and nine elements of Pulvermacher's to produce the same effect.

The resistance of the body is *nil* when 240 Pulvermacher elements are made use of.

In experiments with the galvanometer the penetrative power of the Pulvermacher elements in comparison was most marked.

| *Daniell's Cells.* | *Galvanometer Recorded.* | *Pulvermacher's Elements.* | *Galvanometer Recorded.* |
|---|---|---|---|
| 30 without resistance . . . . | 90 maximum | 60 without resistance | 6 |
| 30 transmitted through the body | 8 | 60 through the body . | 2 |
| | | 240 through the body | 6 |

Where the quantity generated by the Daniell's Batteries could tell,—namely, where there was no resistance,—the needle of the galvanometer was deflected to 90, the maxi-

mum; on the contrary, 60 elements of the Pulvermacher could only record 6; but when the body (a resisting medium) was interposed, the quantity of the Daniell's Batteries was useless; and the energy was expended, to a great extent, in the fluids of the batteries themselves, and the galvanometer merely recorded eight degrees; whereas, the same resisting medium being made use of, the Pulvermacher elements recorded two degrees on the galvanometer,—being only four less than the maximum. The energy, or penetrative force, of the chain over the batteries was here most marked. With 240 elements the body went for nothing, and the maximum six was recorded.

The reason for this superiority of the chains over the cells is this:—that the chains hanging freely in the air, the generated electricity has no power of escape, but must travel to the pole in a concentrated form; whereas, in the cells, when a resistance is met with, the galvanism is, to a great extent, forced back upon the apparatus, and expends itself in its fluids and metals.

I am accustomed, therefore, in operating upon the body to make use of an arrangement of Pulvermacher elements of from 60 to 240; and with this, anything that the continuous current can do can be done.

### The Galvanic Bath.

This form of administering the continuous galvanic current is very useful in several forms of disease—in the

muscular atrophy of children, as a general stimulus in complete paralysis, in great exhaustion from wasting diseases, in some forms of scrofulous diseases affecting the joints, tendons, &c.; as a local bath in almost all affections where want of tone, or pain, indicates the application of electricity, I frequently use the galvanic bath; and as I think the method I employ is the most convenient and easiest of application, besides being by far the cheapest, I cannot do better than describe the apparatus and the method of applying it.

The bath itself may be of any form or material; if, however, it is of unpainted metal it must have a sheet put in so as to line it, that the body of the patient do not touch the metal. It should be filled with the necessary amount of water, of a suitable temperature, into which may be placed any salt or drug which may be deemed necessary, as bay salt, acetic acid, &c.

A Pulvermacher chain made expressly for the bath of 60 elements, excited in the usual way, by being drawn through pure vinegar, should be hung up by the hook at the positive pole, to the wall by means of a piece of string of such a length as to allow the negative or white pole to enter the water, but not any part of the chain; the chain should also be free, and not touch the bath, sheet, wall, &c. except where mentioned: by the means of a wire attached to the hook at the positive pole, a conductor, containing a moistened sponge, can be placed

upon any portion of the patient (who has been placed in the water); a current now passes into the body at the positive conductor, issuing out at every pore into the water. Of course there are many ways of availing oneself of the galvanic bath; the whole body may be inserted, or a limb, or merely the hand. There is no shock experienced except upon first placing the conductor upon the patient, then a slight tremor pervades the system, after which nothing is experienced.

A genial glow soon appears, and an exhilaration of spirits, the secretions are freed, and tone sooner or later, according to the case, is the result.

The galvanic bath may be resorted to at any time when a person may not feel in his usual health, during an epidemic for instance, when the electrical state of the atmosphere is not in its usual state.

M. Becquerel, in a communication to the Académie des Sciences of Paris, has demonstrated, that in all running water there is a flow of electricity passing between the earth and the water, and it is probably to this, as well as to the temperature of the water, that the invigorating influence of cold river bathing is to be referred. By adding a little bay-salt to the water in the galvanic bath, the influence of the electricity is much more evident. Here, again, we have a reason for the great value of sea-bathing. A case has just been related to me of paralysis in an infant, which had been much benefited by being

plunged every morning in a running stream; another I know had received benefit from sea-bathing. Still, both these methods are far inferior to the galvanic bath, and without the danger of cold, or the great, sometimes depressing, shock which bathing, injudiciously recommended, produces. More than one chain may be used; two, or even more, attached, the negative pole of the first to the positive of the next, and so on, according to the nature of the case and the age of the patient.

Now, besides merely acting upon the nervous system, there are other methods of using the galvanic bath, which are, I believe, equally valuable, but have not yet received that attention which they deserve. M. Andrès Poey presented a short memoir to the Académie des Sciences of Paris, 1855, entitled "Extraction of Metals, introduced and remaining in the System, by means of Electro-Chemistry," in which he states, that he has succeeded by the aid of an acidulated galvanic bath in withdrawing mercury from the system. Many observers have stated the power of the galvanic current in causing the transport of drugs, &c. through the human body. Amongst others the names best known are Berzelius, Sir Humphry Davy, and Fabré-Palaprat. Faraday has demonstrated the dynamic power of electricity in passing an acid or alkali through various solutions of salts, &c.; but I do not know that he has demonstrated this upon the human body. The last and most recent observations are by Dr. Richardson, in which

he, by the continuous galvanic current, causes the rapid absorption of a narcotic through a part of the body.

Sir Humphry Davy placed his hands in separate bowls of distilled water, in connexion with the poles of a galvanic battery, and observed that at the positive pole phosphoric, sulphuric, and hydrochloric acids were rapidly disengaged from the hand connected with it, whereas fixed alkalies appeared at the other. It is hardly necessary to mention here the experiments of Dr. Edmund Davy, Heidenrich, Gautier de Claubry, &c. who have demonstrated that the most delicate test for mineral poisons is the galvanic current, which will seek out and deposit at the negative pole the most minute portion of the base, out of any quantity of matter with which it may be mixed.

Now the question arises, whether any drug can be caused to pass through the human body by the aid of the galvanic current, and whilst doing so produce any therapeutic effect. The answer to this is anomalous, yes and no, but I will explain. There is quite sufficient evidence adduced by numerous observers of the highest veracity to prove that a metallic salt placed beneath the positive pole will appear at the negative pole at a distant part of the human body; but does this produce any therapeutic effect in its course? Certainly not; and this experiment will completely prove it.

Let there be three distinct glass vessels, containing in the first a solution of common salt, in the second dilute hydrochloric acid, and in the third a solution of litmus,

reddened with a drop of acid. Let the centre vessel be connected with the other two by pieces of moistened thread. Now, into the vessel containing the common salt place the positive pole of a galvanic battery, and into the solution of reddened litmus the negative; for this experiment I used 120 Pulvermacher's bath elements, excited with 1 part of acetic acid to 3 of water.

The decomposition of water immediately commences, and may be observed at the negative pole—bubbles of hydrogen escaping; at the same time the reddened litmus begins to turn purple at the upper part of the vessel where the cotton enters the fluid, showing that soda is passing over to neutralize the acid, and allow the litmus to take its natural colour; the point of deepest colour and most action is where the wire of the negative pole approaches the moistened cotton. A cloud collects round the positive pole.

Here we perceive that soda has been driven through the solution in the centre vessel without in any way acting upon it, and yet in the third the acid is neutralized and the purple colour appears; by this experiment, which is very easily arranged, we perceive that the effect only appears at the pole, and not in the intermediate stages. How, then, does a drug act on the organism? The galvanic current acts most powerfully upon the circulating system, stimulating it, and this chiefly at the negative pole; and by this means any drug applied to the surface is absorbed more readily, with the assistance of the galvanic current,

than under ordinary circumstances; and this I believe to be the true state of the case.

Now, it must be evident to all, that if the galvanic current has the power of impregnating a part with any chemical compound or drug, it must be of much greater advantage than in giving drugs, &c. by the stomach, when, in passing through the process of digestion, they must, to a great extent, become altered, and diverted from the particular portion of the organism we may be desirous to affect. Thus, in gouty deposits, the acid which we may wish to act upon the extremity can be directed immediately upon the spot, instead of passing through the stomach and circulation, and being entirely decomposed before arriving at the desired position.

I do not venture to speak more fully upon this subject in this place, as I wish the pamphlet to be as much as possible of a practical nature; but still these hints carried out by observers will doubtless lead to much good, as also, I hope, from my own experiments and observations upon the subject, which I do not cease to carry out at every opportunity. I have some cases in which I made use of the bromide of potassium as a salt for introduction, but I at present withhold them as not being of sufficient importance as regards their results to bring before the Profession. I do not venture either to give an opinion upon the electro-chemical bath of M. Poey. M. A. Becquerel of Paris, and M. De la Rive of Geneva, both

authorities, doubt its being able to extract metals from the body.

## Electro-Physiology.

In Bernard's experiment of dividing the sympathetic in the neck (corroborated by Handfield Jones and Brown-Séquard), that side of the head inflames; in other words, a larger supply of blood is attracted to the part; the ear and eye become red, are hotter than on the opposite side, even to twenty degrees Fahrenheit; and, if the animal be a weakly one, suppuration of the conjunctiva may supervene.

There have been various reasons adduced to account for these phenomena, M. Brown-Séquard's being, that the sympathetic controls the muscular coats of the arteries, and when the nerve is divided upon one side, those vessels which received their nerves from the divided trunk are paralysed and dilate, allowing a larger supply of blood to pass to the part. This is an admirable remark, and worthy of the great experimenter to whom we are indebted for it; still, I believe it to be only half the truth, the other half being, as I have explained in the Introduction to *Nervous Affections*, p. 70, "The sympathetic system of nerves above the portion severed is nearly cut off from the centre: ... the part itself having its vitality nearly under its own control, it is not affected by what is going on

elsewhere; it does not *know* that the stomach, the spleen, or the liver may want a larger supply of blood, therefore it takes all it can get for its own nutrition; more blood is attracted to the part; tissue change goes on rapidly; even stasis may take place, and suppuration be the result, the blood not knowing that it is required elsewhere, from the communication with the centres being for the most part cut off."

"If, however, the nerve be galvanised, we find a very different state of things; the blood circulates more rapidly; the capillaries, instead of attracting and retaining the blood, pass it on, and there is an opposite condition of the part; it may become even colder than on the other side. Here the centre has excess of power over the peripheral corpuscles, and the blood is not allowed to accumulate in the part, but is sent on;" also, the muscular coats of the arteries contract upon the blood and force it onwards. "We arrive at this rule—that where the centres are powerful, blood is not allowed to accumulate in the periphery, except where required. When the centres are weak, blood accumulates in the periphery, and over-action occurs in the part," &c.

These observations are of the greatest value in leading us to a rational method of employing galvanism, as we are enabled, in treating affections of the sympathetic system, to apply with confidence a direct or inverse current, according to whether we wish to stimulate a part, or, on the other hand, to counteract hyperæsthesia.

The following observations of the effects of the different

descriptions of galvanic currents upon the nerves, are collected from the writings of the most distinguished experimenters in this field of inquiry. Professor Matteucci, followed by M. Dubois Reymond, have distinctly proved that electric currents circulate in the muscles of live animals, independent of the spinal cord and spinal and crural nerves, even if the animal be deprived as much as possible of all the nervous filaments ramifying in the muscles; consequently, the electro-motor element is reduced to the muscles themselves.

There can be little doubt that powerful electrical currents exist in the muscular system of all animals. The first philosophers, from Matteucci to Dubois Reymond, from Humboldt to Becquerel, have allowed this. Professor Matteucci, than whom there is no greater authority in electrical physiology. gives the following as the laws supervising the muscular currents :—

The intensity of the currents varies according to the temperature of the medium in which the animal has lived.

The duration of the currents after death is so much the less as the animal is raised in the scale of creation.

The intensity varies with the degree of nutrition of the muscle, and is always strongest in those muscles which are gorged with blood and inflamed.

They are altogether independent of the integrity and activity of the motor and sensorial nervous systems.

The influence of narcotic poisons is null, or very feeble, on this current.

That the current proper of the frog persists in its intensity and direction without the spinal cord, or the spinal and crural nerves, and even if the animal is deprived of all the nervous filaments of the muscular mass of the thigh.

That the electro-motive element of this current is confined to the muscles of the leg and of the thigh organically united.

Below will be found the opinion of the illustrious Humboldt upon the muscular current:—

"At a meeting of the Academy of Sciences, M. Arago read the following note from the illustrious Humboldt:—

"'Neither the jeers of certain editors on German credulity, nor the negative results obtained by two of our first natural philosophers, have changed my convictions regarding the influence of muscular action on the movement and direction of the galvanic needle. We have recently repeated our experiments at M. Reymond's, and I invited M. Mitscherlich to attend, knowing his great dexterity in the management of delicate instruments. On giving tension to the muscles of the left arm, the needle was instantly made to move by M. Mitscherlich, and that in the direction predicted by M. Reymond; viz. one indicating a current from the hand to the shoulder of the arm which was in action. On stiffening his right arm, M. Mitscherlich made the needle move in an opposite direction, and traverse a smaller number of degrees; this arises from the fact, that the energy of muscular contraction is not always the same in both arms. Occupied as I

have been for more than half a century with physiological researches of this kind, the discovery of M. Reymond has deeply interested me. It is a vital phenomenon, rendered sensible to us by an instrument of physics.'

"In connexion with the same subject I may mention the result of some curious experiments recently made by M. Ducros. The conductors of a galvanometer were applied, one to the forehead, the other to the neck. The needle remained steady, and marked forty degrees. The patient's thigh was now strongly pinched, and, under the influence of the pain, the needle passed to eighty degrees with great rapidity. The experiment, frequently repeated, gave the same results; and M. Ducros hence concludes 'that all causes which increase vital activity react on the galvanic needle at a distance from the point of their immediate action.'"

Mr. Rutter has still more admirably proved the existence of these muscular currents (see his work on Human Electricity). He has devised an apparatus consisting of two bowls filled with water; at the bottom of each bowl is a metallic handle, communicating by a wire with an extremely delicate galvanometer. Upon placing the hands gently upon the handles, the needle of the galvanometer is not deflected; but upon contracting the muscles of the arm, the needle is sensibly affected in one direction; and the muscles of the other arm being contracted, the needle is deflected in the opposite direction. This experiment has been repeated in Paris and confirmed.

This, therefore, may be considered as conclusive of a muscular electric current circulating in the human body. Those readers who wish to enter more fully into this most interesting subject, can find all the evidence in De la Rive's "Treatise on Electricity;" the following being a short epitome (De la Rive's "Treatise on Electricity," Vol. III. page 50):—

"We may now regard as demonstrated in a decided manner by the researches of Matteucci and Dubois Reymond—1st. That there exists both in the muscles and in the nerves of all animals, a natural electricity, independent of mechanical, physical, or chemical actions, whether exterior or interior. 2d. That this electricity is manifested under the form of closed currents circulating along the muscles or the nerves of the animal, and of which we can collect but a very small derived portion by the assistance of our instruments. 3d. That the presence of this free electricity is subordinate to the state of the life of the animal, and it disappears with the vital force. . . . The laws that govern the electric state of the muscles and nerves are those of their elements."

The illustrious Haller came to the conviction, after many ingenious experiments, that the rapidity of the nervous fluid was at the rate of 9,000 feet a minute. Aldini, a by far more skilled physiologist, on account of his researches in animal electricity, after experimenting, failed to discover its rate. In his second dissertation on animal electricity, read in the Institute of Bologna in the year 1794, he says:—"When this arrangement was made (namely, a conducting medium

150 feet long), the two extremities of this very long arc were applied to the armed nerves and muscles of a frog; and the animal electricity, being thus excited, instantly proceeded with so much velocity from the one extremity of the conductor to the other, that no difference could be perceived between the time when the frog touched the conductor and that when it began to be agitated. This circumstance seems to prove, in a striking manner, a great similarity between the nervous fluid and common electricity." It may be imagined that since then, the wonderful improvements in mechanism would afford us more accurate ideas of the rate of the nervous current; and this has been the case. An apparatus has been invented by M. Fizeau, to mark extremely minute divisions of time, even to the millionth of a second. By this apparatus, the time required for the centres to reflect the stimulus of the interrupted galvanic current has been computed.

I. Sensations are transmitted to the brain at the rate of 180 per second.

II. The brain takes one-tenth of a second to act upon a muscle by its motor nerve. This of course varies in individuals differently constituted; but it gives one an idea of the time required to produce an effect, after the mind has originated the desire to cause it.

M. Dubois Reymond has also, by a series of most ingenious experiments, demonstrated the course of the electric current of nerve force in the nerves themselves.

In the nerves of sensation and motion the current circulates in the same direction, and upon irritating the nerve it is propagated in all directions equally.

I. The muscular current is not permanent, but is composed of a rapid succession of simple and sudden variations of intensity. It does not recover its intensity immediately, but gradually after the contraction has ceased.—(*Dubois Reymond.*)

II. The nerve differs from the muscle in its electric relation in that, when it is traversed in a portion of its length by a continuous current, the entire nerve assumes an electric state, which has been termed electrotonic, whence results the production of a current which, according to its direction, increases or diminishes the effect of the ordinary current. The electric phenomena are identical in the nerves of motion and in those of sensation; both of them transmit the irritation in both directions equally.—(*Ibid.*)

III. When a current of electricity is passed through the limb of a living animal, it contracts, and pain is experienced both at the closure of the circuit and upon breaking contact, in whatever direction the current may be passed; but after some time the irritability of the nerves is lessened, so that we find that when the current is direct, the muscles contract when the circuit is closed, and pain is experienced when it is broken. When the current is in the opposite direction—namely, from the periphery to the centre—pain is experienced upon closure of the current, and contraction upon

opening it. This fact must not be forgotten, as it will lead us to some important results.

IV. Whatever may be the direction of the current when it is intense, all the muscles to which the nerve is distributed, of which one part is traversed by this current, contract at the moment when the circuit is closed, or at the moment when it is opened, and there is at the same time pain. So long as the circuit is closed there is neither contraction nor pain, which is due to the particular state in which the passage of the current places the nerves and muscles. We likewise know that the contractions are more powerful at the opening than at the cessation of the direct current, and that the contrary is the case when the current is inverse, whilst the pain follows the opposite course. The action of the current upon a mixed nerve of an animal recently killed, or living, is remarkable. If a continuous current is caused to circulate in it, excitability is diminished or destroyed when the current is direct; it is preserved and even increased when the current is inverse. If this same nerve has been traversed by the direct current, repose restores to it very promptly a portion of its excitability; if, on the contrary, it has been traversed by the inverse current, it loses by repose a portion of the excitability which the passage of this same inverse current had imparted to it. All these experiments require, in order to their success, feeble and moderate currents — intense currents always diminish the excitability of the nerve, and sometimes completely suppress it for a certain time. This

diminution or suppression takes place in a higher degree when the current traverses the nerve from the periphery to the centre, than in the opposite direction, which is that of the natural current that takes place in the nerve, at the moment when, under the influence of the brain, this nerve determines the contraction of the muscle to which it abuts.—(*Matteucci.*)

M. Remak thought that he could prove that continuous currents possessed the property of causing contraction to cease, by preserving to the muscles the faculty of obeying the will, and in restoring it to them, even in the case in which they might have lost it.

V. When an electric current is passed along a mixed nerve, if it circulates towards the brain, a sensation is experienced; if in the opposite direction, muscular contraction follows; from this it appears that a nerve cannot at the same time transmit the desire of motion to a muscle, and the sense of pain from it.

VI. If a continuous current is made to circulate through a mixed nerve, its excitability is diminished when the current is direct; it is increased when the current is inverse. M. Remak thought that he could allay morbidly excited muscle by the passage of a direct continuous current. M. Matteucci has also recommended continuous currents of electricity for the cure of tetanus.

Now, what is the effect of galvanism upon the circulation? The galvanic current stimulates the heart and arteries to

increased muscular contraction, the consequence being an increased flow of blood; it has also the same effect upon the venous system; the tendency to venous congestion, so common, is rapidly removed by the stimulus of electricity. But there are some forms of chronic congestion in which the powerful stimulus of the galvanic current is not suitable, or even convenient; in such the mild continuous current is more adapted; it has the same effect in a slighter degree, but from the convenience of its application it may be much more suitable.

Again, a chronic case requires a more protracted treatment, and a weak continuous current does much more good than a powerful stimulus, used merely for a short time. However, I am myself accustomed to make use of both currents—a continuous current, constantly passing, the patient wearing one of Pulvermacher's chains, and the induced, interrupted current, with the aid of the apparatus of MM. Legendre et Morin. M. Duchenne asserts that the current of electricity in the induction wire has very different properties from that induced in the secondary coil—the first being always in one uniform direction, the latter having a to-and-fro direction; the former having more influence upon the muscular system, the latter upon internal organs and the skin. I believe that this latter assertion is not correct; it is true that the induced current has much more penetrative power—resembling, in fact, the electricity generated by an electrical machine, and in that way it has a greater stimulant effect upon deeper organs,

simply because it is enabled to reach them ; but it also has a greater effect upon the muscular system, in my opinion, and this may be easily understood by referring to observation IV., for being a to-and-fro current the excitability of the nervous system is retained and stimulated instead of being weakened, as would be the case by a current being passed in the same uniform direction.

The rapidity of the intermittences must not be lost sight of. It is important that the currents should follow one another as rapidly as possible, so as to imitate the natural muscular current (obs. I.) ; they are useful, also, when we wish to excite the sensibility of the skin.

There are two methods of stimulating the muscular and nervous system by electricity—the first is by localising the electricity in a nerve or muscle, by placing the conductors close together so as to localise the current in a nerve, one conductor on the peripheric termination of the nerve, and the other upon a spot in its course, or upon the ganglion, according to circumstances ; and, in a muscle, one upon its sensitive spot (where the nerve enters), and the other near its insertion. The second method is by reflex action, where the current enters at the periphery of a nerve, passes to its centre and is reflected, and finds its exit at some distant part. This latter requires more care and management, as it might occasionally induce a tetanic state, as I shall presently show.

Feeble to-and-fro currents are suited to those cases in which a long-continued action is necessary, as the excitability of the

nerves is retained for a much longer time under its stimulus; they rouse up vitality and exercise a tonic influence over the organic life of parts, principally by stimulating the various muscular tissues to contraction; care, however, is required that the currents are exactly measured to the requirements of the case, otherwise, as Matteucci observes, "an intermittent current excites tetanic convulsions, but sooner exhausts the excitability of the nerves than the continuous current." On the whole, therefore, when passing electricity through any important nervous centre it is advisable to make use of the continuous current.

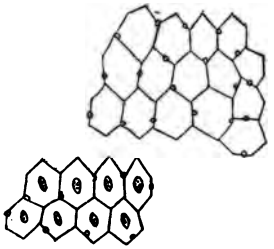
### The effects of the Galvanic Current upon the Circulation in the living Frog, as seen under the Microscope.

I had the pleasure of exhibiting before some thousands of eager sight-seers, the effect of the continuous galvanic current upon the circulation in the web of the frog's foot, at the *soirée* of the Microscopical Society, held this year at the South Kensington Museum.

In the introduction to my work on nervous affections, I have given the microscopical anatomy of the tissues of the web, of which what follows is a short *résumé*. "Upon focussing gradually a good quarter object glass, minute nipple-like processes slightly raised above the surface of the epithelium first present themselves to the view; they are situated at the margins of the hexagonal epithelium scales, one or two

to each, and are the mouths of minute tubes which pass between the scales. The epithelium is tesselated, hexagonal, and perfectly transparent; that is to say, that during life, and except under the stimulus of re-agents, the epithelium cells *contain no nucleus.*

Fig. 5. *Nervous Affections.*

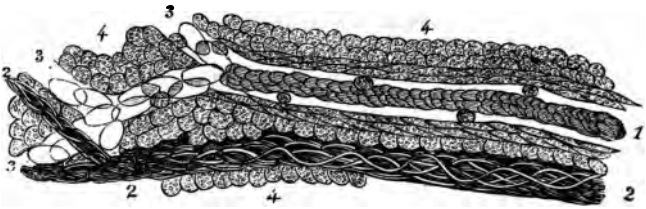


The Epithelium of the Web (frog's foot), showing the minute nipple-like openings. The nuclei in the lower figure appear after death, or by the agency of acetic acid.

Beneath this external layer lie the proper tissue cells of the web; they are packed closely together, are oval, and not flattened. The serum penetrating between them, retains their plump form; they have a granular appearance, and are not transparent. Bored between these cells are the capillaries —their coats being the cells themselves, which, by the constant attrition of the circulating corpuscles, are perfectly smooth. Entering at the side of the web, and running side by side, are the principal artery and nerve supplying it. Of the same diameter as the artery, the nerve is formed by the interlacement of numerous dark-bordered tubules. The coats

of the artery are formed of two or three layers of elongated flattened-out cells, overlapping one another like tiles; upon division there is only one layer of flattened cells, and in the capillaries none.

Fig. 6. *Nervous Affections.*



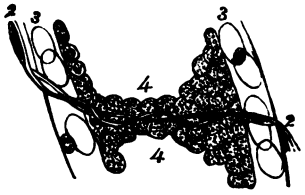

THE MINUTE ARTERY AND NERVE OF THE WEB OF THE FROG'S FOOT.

1. The artery; the coloured cells flowing through the centre of the tube; the colourless globules dragging along the walls; the elongated cells forming the coats are shown.
2. The nerve formed of dark-bordered tubules.
3. The capillaries branching off from the artery.
4. The cells forming the tissue of the web.

The flow of blood is so rapid in the artery, that the coloured corpuscles cannot be distinguished as they pass through the centre of the vessel; but dragging and bounding along the sides with the serum, the pale globules may be seen impelled onward by the force of the circulation. The blood is of a rusty yellow colour, but red where many cells are collected together. If the frog be made to struggle violently, *arterial circulation is arrested,* the veins on the opposite side of the web become clogged, and the blood in the capillaries flows backwards from the vein to the artery.

Upon arterial circulation being reinstated, there is a see-saw motion in the capillaries, the blood flowing backwards from

*Nervous Affections.* Fig. 13.



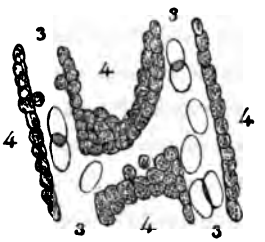

TWO NERVE-TUBULES PASSING FROM ONE CAPILLARY TO ANOTHER, CROSSING THE INTERCAPILLARY TISSUE.

2. The nerve-tubules. 3. Capillary.
4. Tissue-cells in the frog's web.

the vein meeting that from the artery; however, after several oscillations the circulation is again restored. . . . Occasionally

Fig. 8. *Nervous Affections.* Fig. 9.


CAPILLARIES blocked with blood corpuscles.




The same CAPILLARIES; the circulation stimulated by the continuous galvanic current.

a capillary may be seen of smaller diameter than the average, in which several white globules are collected.

Upon applying a gentle continuous current to the web, by placing the positive pole to the leg, and the negative to a toe, after the first start of the frog, the circulation will be observed to be much accelerated, the arteries supply a more rapid stream, the corpuscles in the capillaries flow much more quickly, the veins also carry off the blood more freely.

This rapidity of action lasts for a considerable time if the strength of the current is sustained.

If an interrupted current be applied, then, by causing muscular contraction, capillary circulation is arrested, and for as long a time as the stimulus is continued; in fact stasis may be induced by long-sustained contractions. If these two facts be considered, many interesting physiological phenomena may be explained by them, which I hope to touch upon in another work.

The effects of the galvanic current upon the heart is at present a vexed question, and I have not myself had sufficient experience to define the method of application to produce contraction or to allay irritation. I have no doubt, however, that the heart might be stimulated to regular contraction in case of syncope, or from suspension of contraction from mal-administration of chloroform; or, on the other hand, that it might be controlled in fever, &c.

The following are the results of some experiments undertaken by the Biological Society of Paris,—a young but most excellent society; containing amongst the members some of

the first names of the day of those who investigate Nature to draw forth her secrets in the cause of Truth.

Some experiments were recently performed before the Biological Society, for the purpose of clearing up certain doubts which a well-known physiologist had thrown on the assertion of the Germans, "that the pulsations of the heart are suddenly and passively arrested by galvanising the medulla oblongata, at the origin of the eighth pair of nerves."

M. Longet denies the truth of this proposition, and affirms, on the contrary, that the heart has ceased to pulsate, because the stimulus has thrown it into a state of permanent contraction. According to M. Longet, the idea of the suspension of action in any organ at the moment the nervous system which animates it is powerfully stimulated, is opposed to all previous knowledge, and to actual experiment.

The demonstrations of M. Brown-Séquard before the Biological Society leave no doubt of the fact announced by the German physiologists, and at the same time of M. Longet's error. When the two extremities of a powerful galvanic battery were applied to the medulla oblongata, close to the origin of the eighth pair, the pulsations of the heart ceased; and when the galvanism was kept up for a short time, the heart became black and swollen, because the blood flowed constantly into it, yet was not expelled.

On the other hand, if one pole of the machine be connected with the heart, and the other with the root of the vagus, then

the heart really contracts and ceases to beat, as described by M. Longet. The mode of applying the stimulus, then, makes the whole difference.

In this experiment by M. Brown-Séquard, the continuous current was used; and it is hardly necessary for me to repeat that, in all experiments upon the heart, this form of current must be employed. Much has been said against the use of galvanism in impending death from chloroform; but this has been said by those who are ignorant of its powers and uses. Galvanism properly applied is, I believe, the only remedy that would rouse the heart from impending paralysis by poisoning with chloroform.

To Dubois Reymond, and to Matteucci, are we chiefly indebted for investigations in electro-physiology; to Duchenne, Remak, and A. Becquérel are we chiefly indebted for investigations in electro-therapeutics; and although I firmly believe that these latter gentlemen are mistaken in the apparatus they employ, still to both of them our best thanks are due for the continued labours they have bestowed on this most interesting question; and I cannot but believe that, at no very distant date, they will reconcile the anomalies in their various methods, so that each form of electrization—the continuous galvanic current and electro-magnetism—will take its proper and deserved position in therapeutic science. It would be, perhaps, presumptuous in me to call the attention of these gentlemen, if they chance to read these pages, to the rules I have laid down for the application of each form of

current. Still, it is my belief, that it is in the judicious choice of the different physiological effects of each current that success in the treatment of disease depends.

## Electro-Therapeutics.

Having given the results of experiments made principally upon animals, showing the effects of the different forms of the galvanic current upon the nervous and muscular systems, I now propose to bring forward the results of its application upon man, when from any cause he has lost the tone of health.

The most simple method of applying galvanism to the human body is in the case of torpid ulcers, as those in the legs of old people, &c. where, through the want of vitality in the part, the ulcer will not heal; in fact, slowly spreads. Nothing is so useful as galvanism; nothing can compare with the rapidity with which a new character is given to the flabby granulations, which now spring up red and healthy, and the ulcer quickly heals. A disk of silver, a little larger than the ulcer to be healed, is attached to a plate of zinc three times the surface of the silver, by a wire long enough to allow the zinc to be placed on perfectly healthy skin *above* the ulcer, so as to allow a *direct* current of electricity to pass. The silver being placed upon the ulcer, the limb is bandaged, so as to retain the plates in apposition and to give uniform support; under the zinc plate place a piece of flannel, *always kept moist*

(otherwise the current will not pass), either with water, salt and water, or diluted acid. By modifications of this apparatus, according to circumstances, any sore may be treated. I have used it with success for sore nipples.

*Case* 1.—Miss T. had had a chilblain on the inner side of the right ankle. Last winter twelvemonth this had broken, and gradually spread during the ensuing summer. In the next winter it had progressed so as to be half-way up the inner side of the calf: it had an indolent appearance, and was offensive. Miss T. consulted me in the spring of 1858 for hemiplegia of the right side since infancy—she then being fifteen years of age. No treatment to the sore had ever been of the slightest benefit to her, and she willingly consented to try the galvanic plates: and, although it may appear extraordinary, still it is no less true, that within three weeks the whole wound was completely healed, and it has since remained so. The method of action is to increase circulation in the part; at the same time some chemical change in the salts of the blood takes place, which, at the negative plate, has a healing effect.

*Case* 2.—Sir J. P., Bart.—This gentleman had suffered for more than a twelvemonth with a gouty wound between the metatarsal bone and the first phalanx of the great toe, with occasional extrusion of, according to Mr. Cæsar Hawkins, pieces of bone, but which I believe to have been masses of urate of soda. He could get no benefit. Being consulted, I recommended the application of a small galvanic

pair, zinc to the dorsum of the foot, and a solid silver plug to pass to the bottom of the wound. This afforded immediate relief of pain; and upon removal every other day, small masses of the urate always followed. In spite of constant exercise, blows, &c., this little apparatus always had the power of removing the pain and inflammation.

## PARALYSIS.

Paralysis induced by eccentric irritation sometimes comes on by degrees, sometimes suddenly. I have seen a very peculiar case in which the tongue was completely paralysed and the right arm partially so; came on slowly, and has been getting worse for upwards of a year. Again, another instance of hemiplegia in an infant came on suddenly; another in an infant came on gradually, with occasional exacerbations. The first of these cases was caused by cold; the second by dentition and weaning; and the third by damp. Cold and damp usually induce paralysis of the sympathetic system, the vaso-motor system, and a cold, catarrh, cough, diarrhœa, fever, or rheumatism, &c., is the result; but much more severe paralyses result, occasionally, from the sudden shock of cold or damp to the skin. The result of injury to the cutaneous surface, reflected to central organs, is well shown in burns; a severe scald may give rise to inflammations within the abdomen, chest, or head,

determined by circumstances peculiar to the individual. This arises from a reflection of the depressing influence from the cutaneous surface to the internal part.

Even mental emotion may be reflected to the heart, causing sudden death by syncope.

The inhibitory system of nerves, or those whose function it is to arrest or diminish action, is but a name for certain normal states of the ganglionic system, which undergo at regularly-recurring periods exaltation and depression. Mr. Joseph Lister, in a paper of interest published in the *Proceedings of the Royal Society*, No. 32, comes to the following conclusions in reference to this system:—"It may be looked upon as a fundamental truth not yet explained, that one and the same afferent nerve may, according as it is operating mildly or energetically, either exalt or depress the functions of the nervous centre upon which it acts. It is upon this that all inhibitory influence depends, and I suspect that the principle will be found to admit of a very general application in physiology and pathology." This must be an admitted fact; but the times when some portions of the nervous system are exalted and others depressed are not as yet fully defined, nor are the causes clearly made out, although many of our first physiologists are engaged upon these investigations—Bernard, Brown-Séquard, and others. I have myself thrown out some hints, in my Introduction to *Nervous Affections*, upon the generation and distribution of the nervous fluid; which I believe, both theoretically and

with respect to the practical working of applied galvanism, are the least complicated and the easiest to understand.

Thus the idea of eccentrically induced paralysis may be more clearly understood, and the method of successful treatment imagined. It is true we find the muscles completely paralysed, and, as Dr. Friedberg has ascertained by dissection (see *Ziemssen's Die Electricität in der Medecin*), that in muscular palsy the arteries are much diminished in size, but this is merely the result of want of use. The injury induced by the primary cause—cold, damp, or whatever it may be—has long passed away; and if we can bring back by exercise the tone of the muscles, and increase the circulation of the part, the centre, the cord or brain, will regain its influence over the paralysed muscles, and their functions will be restored.

Such is a brief outline of the theory of eccentrically induced paralysis. I will now give the method I have myself found pre-eminently successful, effecting cures which have astonished the patients, and even myself. The circulation of the part is diminished: this must be increased. This is easily accomplished with the aid of the continuous current, as generated by the Pulvermacher chain, which should be frequently excited and constantly worn. The direct current being employed, the part will become warm, and remain so as long as the chain is applied. If there is any want of cutaneous sensibility, those parts must be stimulated by Faradisation occasionally, every other day or so. The

paralysed muscles must be stimulated to contraction by the localized current of the electro-magnetic apparatus.

One of the most striking instances of cure of eccentrically induced paralysis was a case of complete paralysis of the deltoid, with perfect anæsthesia of the skin covering it. The man had caught cold by getting wet through; he was an out-patient at St. Mary's Hospital, under Dr. Handfield Jones, who, after trying every form of treatment without the least benefit, recommended a Pulvermacher chain to be worn, direct current from the nape of the neck to the insertion of the deltoid. In four months the man called upon Dr. Jones perfectly recovered, with complete use of the deltoid, and he is now at his work in a brewery.

## INFANTILE PARALYSIS.

### Progressive Fatty Muscular Atrophy.

There are no diseases more complicated or difficult to understand than these. Having had several cases which have much interested me, I shall dwell more on them than I shall on others, being more instructive, and the various methods of treatment which I shall speak of in the treatment of these cases will combine all that I am accustomed to use.

M. Cruveilhier first defined the cause of progressive muscular atrophy to wasting of the anterior roots of the spinal

nerves, followed by wasting of the muscles supplied by those nerves, and in some instances fatty atrophy. In those cases where the muscles are only wasted without degeneration, electro-muscular contractility is present; but where they are converted into fat, of course there is no contraction upon the stimulus of electricity.

Where the anterior roots of the spinal nerves have wasted, M. Duchenne believes, founding his opinion upon some experiments made by Claud Bernard, that new nerve-conductors to the centres are created, by which the electricity is conducted to the centre. Besides this disease, there is another—namely, true progressive muscular atrophy—where the muscles themselves appear to be more in fault, and not the nerve centres of the cord and brain; or in my opinion the sympathetic system of nerves is more the seat of disease than the cord or brain.

I shall now bring forward four cases where the symptoms vary somewhat, but in which I believe the seats of disease to be very differently situated.

### Case 3.—Paralysis and Atrophy from Wasting of the Anterior Roots of the Spinal Nerves.

Master B. B——, aged ten years, although thin and delicate, had enjoyed very good health to between four and five years ago, when he slept in a damp bed. This was

followed by wasting of the muscles of the back and thighs, and general marasmus. His appetite remained good, and he slept well. Had been under every conceivable form of treatment without benefit, when, on his father consulting Sir Charles Locock concerning him, he was recommended to me.

I diagnosed the case as one of wasting of the muscles from atrophy of the anterior roots of the spinal nerves, and held out hopes of ultimate recovery, time being required to effect the cure.

The treatment I recommended was daily, for one quarter of an hour, to take a galvanic bath, direct current, the positive pole between the shoulders; to wear constantly two long Pulvermacher chains from the spine to the legs; and daily for three quarters of an hour to have the paralysed and wasted muscles stimulated to contraction by the electro-magnetic machine.

I found that, with the exception of a few muscles of the leg, the muscles did not contract to the stimulus of the current, clearly proving that the muscles had completely wasted, and had become fat, or that there was no communication with the cord. I however persevered, and in the course of two months all the muscles of the legs had yielded, and contracted to the stimulus. I now commenced upon the back, and in about the same time they all yielded, and not only so, but markedly increased in size; so much so, that whereas before I commenced there had been a deep groove

on each side, between the ribs and the spine, this was now filled up.

When he commenced treatment, he was continually falling, and could not walk up-stairs; he could now walk a considerable distance without falling, and could walk up-stairs without aid; his gait, however, was still very awkward, showing that there were still many muscles not yet awakened from paralysis.

He is still under treatment.

A remarkable circumstance in this case is, that all muscles supplied by the sacral plexus were perfectly healthy, the calves and glutei were strong and well developed; the injury therefore did not extend to the sacral portion of the cord.

I do not consider that the sympathetic nerves were here affected.

## Case 4.—INFANTILE PARALYSIS—HEMIPLEGIA.

### Injury in the Brain (Corpora Striata?), connected with Dentition.

Miss M. M——, aged 9 years, consulted me December 28th, 1858, for paralysis of the arm, hand, and leg of the left side.

*History.*—When about a year and a half old, she was taken out of bed, hemiplegic on the left side; she was travelling with her parents in India, and sleeping in tents;

it was supposed paralysis had been induced by damp—she was very backward with her teeth and speech.

After some time she improved, and was able to walk round a room with the aid of the furniture; when about four years old, after lying upon damp grass, she was again attacked, and was completely hemiplegic; she recovered a little the use of her leg, and could hobble about on coming to England. The hand, arm, and leg were much contracted and wasted.

She has been a patient at the Orthopædic Hospital, having been operated upon without benefit. She has had unremitting care taken of her whilst in England by her aunt, with whom she is residing; her spine, arm, and leg are rubbed with a stimulating embrocation night and morning; the right arm has been confined, and the left encouraged as much as possible; hitherto without giving any power to the hand, although it has increased in size, and is less contracted.

*Diagnosis.*—Paralysis of the extensor muscles of the fore-arm and hand complete, as also the supinators; contraction and partial paralysis of flexors; leg not examined.

Electro-muscular contractility very good in almost all the paralysed muscles, except those of the thumb and ring-finger. Leg and arm always cold.

*Prognosis.*—Return of voluntary motion in all affected muscles with the aid of galvanism.

*Treatment.*—Continuous current by the aid of Pulver-

macher's chain from the spine to back of the hand; electric bath to the lower arm night and morning for a quarter of an hour. Localized interrupted electricity, to bring out the paralysed muscles, daily for a quarter to half an hour.

*Progress.*—January 4th, 1859.—Very good electro-muscular contractility in all the affected muscles; very slight muscular sensibility. Can move the thumb out slightly from the hand, can elevate the hand on the wrist, and the fingers on the hand a little. Has slept remarkably well since the treatment has commenced, and the hand and arm have been warm; in the morning she is able to move her hand better than during the day.

The leg although not treated has improved, probably from sympathy.

January 8th.—Examined the leg; partial paralysis and wasting of the muscles of the calf and tibial regions, there being an inch difference in the circumference of the two legs; electro-muscular contractility weak.

Localized galvanism to the affected muscles.

January 17th.—Is improving; can take up a shilling with the thumb and fore-finger, and retain it; can move all the fingers separately, the third but slightly; the hand remains open, the thumb not being fixed in the hand.

To attend and be galvanised locally thrice a week.

The continuous current as before; daily bath.

January 24th.—Improving slowly.

February 21st.—Can supine the arm better, and is also otherwise improved; but, owing to extreme thoughtlessness, she has not progressed very much with her home exercises.

March 3d.—Continued continuous current at home, and received the stimulus of the electro-magnetic current twice and three times a week until March; when it was thought advisable that she should remove to the sea-side for the summer months, there to continue the treatment by the continuous current. She can now do almost anything she is told, but evidently with extreme exertion and fatigue, and it appears difficult for her to excite the proper nerves to cause the contraction of a muscle, as when told to move the little finger she occasionally moves the thumb, and *vice versâ*. There can be little doubt that, with perseverance on her part, she will entirely regain the use of her hand and arm.

## Case 5.—INFANTILE PARALYSIS.

### General Progressive Muscular Atrophy.

This is not a common affection by any means; although I have seen a few cases. The whole body is seldom paralysed for any length of time, some portion, such as the head and trunk, usually soon regaining some power. The following most interesting case, was one of complete paralysis of voluntary motion; and is perhaps the most satisfactory instance of

the successful treatment of disease in an infant less than a twelvemonth old on record.

Progressive muscular wasting with paralysis has up to very lately been always considered fatal; it is frequently hereditary, and usually supervenes upon teething; it terminates in death when the respiratory muscles are attacked, the infant ceasing to have the power to breathe. It appears to me that during dentition, instead of the irritation being, as is usual, reflected to the sympathetic system of nerves, it is in these cases reflected to the spinal system, and paralysis of voluntary motion results.

It is not uncommon for infants to be paralysed for a time, and thoroughly regain their powers, no treatment having been used, beyond sea-bathing, or a little alterative medicine; but this is not the disease I speak of; it is where the little patient wastes with loss of power, where we have an anxious staring look, dark areolæ round the eyes, a constant little unhappy wail and loss of voice—this is the affection that always ends fatally, except galvanism be made use of.

At the request of Sir Charles Locock, I saw on December the 11th, the Honourable ——, youngest child of the Earl of ——, aged 11 months 20 days.

*History.*—Three months ago, whilst on a visit with his family in Scotland, suddenly, and without warning, he was discovered by his nurse totally paralysed in all the muscles supplied by the spinal nerves—arms, legs, and back; he

was totally bereft of voluntary motion except the head; he was teething at the time, cutting the lateral upper incisors. Lady —— being naturally much alarmed, wrote up to Sir Charles Locock, and the child was treated by the medical man in the neighbourhood, in correspondence with Sir Charles; the child gradually improved for six weeks, regaining voluntary motion in both arms, and slight motion of the toes of the right leg; he remained thus for six weeks; there being no improvement, Lady —— brought her child up to London, and at Sir Charles Locock's request I was consulted.

*Diagnosis.*—With the interrupted current of electricity of the primary wire.

Left arm.—Paralysis of the middle fibres of the deltoid, with electro-muscular contractility and sensibility.

Back.—Paralysis of the trapezius; upper and lower fibres left side, with slight electro-muscular contractility and sensibility.

Partial paralysis of latissimus dorsi, left side.

Paralysis of serratus postici, sacro-lumbalis, longissimus dorsi, of both sides, without electro-muscular contractility or sensibility; the paralysis was more marked on the left than on the right side. The deeper muscles of the back were paralysed, but it is difficult to diagnose their contractility and sensibility through the more superficial muscles.

Partial paralysis of the glutei, oblique, and other muscles

of the buttocks, with electro-muscular contractility and sensibility.

Complete paralysis of the muscles of the thigh and femoral regions, with complete absence of electro-muscular contractility and sensibility on the right side; nearly complete on the left.

Complete paralysis of the muscles of the leg and tibial regions of the right side; complete absence of electro-muscular contractility and sensibility; slight contraction of the flexors of the toes and foot.

Partial paralysis of the muscles of the leg and tibial regions of the left side, *with* electro-muscular contractility and sensibility; slight voluntary flexion of the toes. The child was pale, with dark areolæ round the eyes; expression, painful and unhappy; eyes very intelligent and lively, evidently no disease of the brain; gums pale, no symptoms of the teeth coming on; appetite good; bowels regular; the voice was very feeble, the cry a mere wail, and he could not cough, pointing out a weakness of the diaphragm, abdominal, and thoracic muscles; he could not sit up, but doubled, the back bowing outwards; he lies on his back or stomach, using his arms.

*Prognosis.*—If electricity is applied, restoration to health, and complete recovery in three months; without, death from apnœa, from wasting of the respiratory muscles.

*Treatment.*—11th.—Daily the galvanic bath; one chain battery ten minutes; to wear a 20-link chain from the

cervical vertebræ to sacrum; two 20-link chains from sacrum to right foot; one 36-link chain from sacrum to left foot; chains to be excited three times a day and to be slept in. All the muscles without electro-muscular contractility and sensibility to be excited daily, according to the amount of paralysis, from one to three minutes, with the aid of the localized interrupted current of the primary wire.

19th.—Met Sir Charles Locock.

*Progress.*—Very little as regards the power of the will; electro-muscular contractility and sensibility established in all the muscles affected, except the flexors and extensors of the great toe, right foot, extensors of the toes same foot, and the deeper muscles of the back, left side. Appearance much improved; gums of the lower lateral incisors swollen and red.

Continue treatment.

Bath one quarter of an hour.

24th.—Power of the will over the glutei and external femoral regions of the left leg recovered; also flexors and extensors of the toes same leg; more power in the deltoid, and some use of the trapezius, left side; muscles of the back improved; slight voluntary motion in the right leg.

Continue treatment.

Two battery-chains for the bath, quarter of an hour.

January 1st, 1858.—Can play the left leg slightly; has

good lateral motion in that leg; power of the will over the glutei and external femoral regions of the right leg recovered; can, when held up, "feel his feet," and although not able to stand, has a good deal of firmness in the legs, more particularly the left, which has much more power than the right; electrical contractility in every muscle of the body, except those of the right great toe; there is a good deal of lateral motion in the muscles of the back, but not much power in straightening it; the voice is much changed, is stronger, and has lost the peculiar plaintive tone it had; he has cut the right lower lateral incisor, and the gums are filling with the double and canine teeth; he is altogether much improved.

Continue treatment.

January 8th.—Has all the natural movements in the left leg, although not with complete power; can stand on that leg when supported; right leg improving, but slowly; the back is much flatter, and there is now considerable power in it; he can sit up for a short time unsupported, also throw himself back; the head is firmer; his voice is good, and he can cry vigorously, which he has not done since his attack; he moves himself about in bed, and kicks with the left leg, and the right when flexed; improvement more marked than on any previous occasion.

Continue treatment.

January 15th.—The improvement has not been very

marked this week; he has been a little irritable from teething; the gums are swollen and hot; the conjunctivæ a little yellowish.

Continue as before.

January 21st.—The back is stronger, he can sit up better; muscular sensibility is exalted, so that the application of the interrupted current is painful, and causes him to cry; much more voluntary motion in the right leg; motion in left leg almost natural for the age.

Two chains in the bath.

Interrupted current to be reduced.

January 31st.—The progress has been very great; he now drags himself into a sitting posture by his nurse's dress, and he can sit unsupported; motion very much increased in the right leg, which is getting strong; he can kick with it and slightly bend it; muscular sensibility almost natural everywhere except in the right anterior tibial region; same as regards contractility.

Continue bath, chains, and interrupted current.

February 22d.—Is now so far recovered, that a little apparatus has been constructed for him, so that he may, by having a slight support in the gluteal region, with two uprights for the axillæ, and a stay round the body, propel himself on a little machine on wheels; he is not now so sensitive, and has not made so much progress the last week; his gums are swollen; he is in very good health and spirits.

February 28th.—Can sit up alone and unsupported, and turn over on his back when lying on his left side; when lying with the body upon a chair or sofa, can stand on both legs and move them in every direction, the left more freely than the right, although the right is the firmer of the two and more muscular. Dr. Granville has seen the child, and is astonished at its great muscular development.

March 11th.—Continues admirably, and for his age, which is little over a twelvemonth, he may be considered but little behind in activity his brothers and sisters at the same period; in size and appearance he is a magnificent child, and would strike anybody as such.

I look upon this case as one of reflected excitement from the fifth pair of nerves to the motor roots of the whole spinal set, with, probably, congestion, and partial disorganization of the ganglia. There was evidently no disease of the brain; the sympathetic system was also perfectly healthy, all the vital functions being carried on with perfect regularity.

This disease, when not yielding immediately to treatment, is always considered likely to terminate in deformity or fatally, especially as in this case, when the muscles of respiration were affected.

Romberg, in his work on the diseases of the Nervous System, thus speaks of this affection, vol. ii. p. 361 :—

"It is a fact of special interest, that the disease of

the spinal cord, meningitis, which in infancy may have given rise to paralysis, may have ceased, while the immobility is maintained and increased by progressive degeneration.... The origin of these affections may be generally traced back to the first period of dentition, or to some acute disease, such as an exanthematic fever; after which, and subsequent to an attack of convulsions, or, though rarely, without them, the child, which was previously in good health, is found to be paraplegic; the upper extremities, and in rare cases the bladder and rectum, being implicated. Sensation almost always continues normal.... All attempts at a cure directed against an assumed morbid state of the spinal cord, whether exudation or inflammation, will prove fruitless." Romberg is here speaking of cases of long standing, and I must so far agree with him, that when the disease has been neglected, or, what is worse, improperly treated for many years, it requires some time and great perseverance to effect a cure; but in these cases of infantile paralysis, when taken immediately, I am sanguine of complete and rapid success.

## Case 6.—CONGENITAL PARALYSIS.

### Cerebral Disease.

Miss L——, aged five years.—Paralysed from birth, so that on arriving at the usual age she could neither stand nor speak.

She is well grown and nourished; about the average

size; and but for a slight stoop is perfectly well formed; is very intelligent, with bright, laughing, hazel eyes; she has gradually improved from birth, but so slowly as to be imperceptible, except upon looking back several months; she dribbles from inability to close the lips; makes sounds, understood by her parents and nurse; can stand, but not walk; can crawl, but on her fist, not hands; can make no determinate voluntary motion; moves every muscle, but with no purpose, all spasmodically.

This case is evidently one of injury to the cerebellum, at or before birth; I say injury, because if it had been from mal-development, the rapid improvement under the influence of galvanism could not have taken place. What form of injury I shall not venture to guess at.

To the olivary bodies, from the nerves traced into them, have been referred the power of speech, they being the centres supervising that most important gift to man. Professor Schroeder van der Kolk has endeavoured to prove the same by his pathological investigations; he says: "Thus we regard the corpora olivaria merely as auxiliary ganglia, which by their connexions with the nuclei of several nerves of the medulla oblongata, bilaterally produce a number of combinations of muscular movements. To these belong the combinations required for the articulation of words, for which especially the hypoglossus, and partly, also, the facial nerve, likewise connected with the corpora olivaria, must be excited."

The respiratory tract was in her case healthy, for although she had no power over the lips to close them, either for taking food, in speech, or to kiss; still, as an infant, the purely reflex and instinctive act of sucking she had performed perfectly, in fact, all purely reflex actions were healthy; it was the power of combination of muscular efforts that was absent.

*Treatment.*—A galvanic bath from a 60-link Pulvermacher bath chain every morning for a quarter of an hour; to wear a small chain band from spine to thyroid body, there being a slight enlargement of that organ, with occasional choking fits in the morning; to wear another band adapted to the *tibialis posticus* of the left leg, there being a slight contraction of that muscle; daily to have those muscles that are least used stimulated to contraction by the electro-magnetic current for three-quarters of an hour.

*Results.*—At the end of one fortnight the child could open the right hand and retain it so for half a minute; could make voluntary use of that hand; could walk the length of the room supported by her dress; could close the lips; her words were combined several at a time, and not jerked out spasmodically.

Six weeks: still improving; can walk with the heel upon the ground, without her attention being called to it; sits up stronger; when crawling opens her hands instead of resting on her closed fists; is much better in health, eats better,

sleeps better, and does not have the fits of choking in the night, in fact, has had but one slight one since the commencement of treatment.

## CENTRAL OR CEREBRAL PARALYSIS.

This has been usually looked upon by authors as not suited to galvanic or, rather, electro-magnetic treatment. I cannot, however, agree with this view, as I think, as far as my experience goes, that this form of paralysis yields more rapidly to treatment than confirmed spinal paralysis. The following interesting instance will bear out what I say, for considering the age of the patient it is marvellous the benefit derived by treatment.

*Case* 7.—General Sir J. H., Bart.—This gentleman, 77 years of age, twelve months before I was consulted, after having stood in the damp in his garden, had what is termed a seizure. From this he eventually recovered, with the loss of the use of his left hand and arm, and weakness in the left leg. The latter recovered tolerably well, but the arm remained useless. In the spring of 1859 I saw him; and in spite of his age I thought, from the general tone of his system, from his great flow of spirits, from his anxiety for a cure, and from his happy temperament generally, that some relief might be obtained. I therefore undertook the case with tolerable hopes of success.

*Treatment.*—A 40-link Pulvermacher chain from the nape

of the neck round the arm to the palm of the hand, to increase circulation and remove some stiffness and contraction in the muscles of the fore-arm. Daily the various muscles of the shoulder, arm, and hand were excited to contract by electro-magnetism. In the course of a few days, the contraction in the muscles had entirely disappeared, and has never since returned. On the tenth day the patient involuntarily, on rising from his chair, assisted himself with the left hand, also at meals he occasionally made use of it. He went on gradually improving until he could exercise the hand, and after a month he was enabled to hold his cards and fork. Beyond this he made no progress; but as the heat was excessive during the latter end of June and beginning of July, and as he lost nothing of the power he had obtained in the affected arm, although he himself was much enervated by the heat and confinement, it was considered that he had acquired as much power as was possible this time of the year, and change of air to the country would be beneficial in his relaxed condition.

I have endeavoured, in this portion of my pamphlet, to discriminate between the various nerve-centres which are affected in different cases of paralysis, and the effects of the galvanic current upon muscular contraction.

In a paper lately sent by M. Duchenne to the Académie des Sciences are some important observations on this point. "Paralysis of the upper extremity is divided into two kinds; one in which contractility and electro-muscular sensibility are

diminished or abolished,—as in saturnine palsy, palsy from diseased spinal cord or derivative nerves,—and one in which the contractility is always intact, while the electro-muscular sensation may be augmented, may be normal, or may be diminished. This occurs in cerebral, rheumatic, and hysterical palsies. With regard especially to cerebral palsies, M. Duchenne states, that when contraction is excited with the most feeble current, the contractility of the paralysed muscles appears sometimes greater than that of the non-paralysed. But this difference is so trifling as to be without value, and to be, indeed, not greater than occurs often in a state of health between different muscles. To be able to say that the excitability is augmented, the difference should be much greater than it really is."—(*Gaz. Méd.* Dec. 8.)

## NEURALGIA

Is generally a stabbing plunging pain in a part, or it may be a stinging pricking pain, or a shooting pain, sometimes even a violent itching. I have met with all these forms, but I have never met with a case which did not rapidly recover with the aid of galvanism. I am willing to admit that some few cases, say one in ten thousand, caused by some 'central irritation in the brain, cannot be cured, but I have never met with such an instance.

*Case* 8.—LIEUT. A.—Wounded in the Crimea; had never ceased to suffer from neuralgia in the cicatrix along the

radius of the left arm; this pain was occasionally—especially in damp weather—so severe as to cause him the greatest torment, it was a grinding gnawing pain, as if a rat was continually gnawing at the bone.

This form of neuralgia in a cicatrix is exceedingly troublesome and persistent. It is sometimes found in the stumps of amputated limbs; and depends, probably, upon the hardening and contraction of the tissues from insufficient circulation.

*Treatment.*—A chain band to be wound round the arm, direct current; the negative pole to be retained upon the seat of pain, excited two or three times daily. He obtained instantaneous relief, but I told him to continue the use of the band until the cicatrix became less hard, and the tissue more natural. This he did for three weeks with entire relief; the circulation was much excited, and the cicatrix had not such a dead-white appearance.

## SCIATICA.

This exceedingly painful neuralgia is unfortunately very common; numbers suffer from it who eventually become crippled through its baneful effects; and yet, perhaps, there is no disease more capable of rapid relief and permanent recovery than sciatica. I consider the direct continuous galvanic current as a specific in this disease, except, of course, when it arises from some central cause, which is very

rare. The treatment is so simple that I hardly need to describe it. Place the negative pole upon the lowest painful spot; then wind the chain band round the leg, the positive pole being placed upon the spine; excite the chain more or less frequently, according to the severity of the pain. If this be continued for three or four days, in the most obstinate cases, and for as many hours in more recent and less severe ones, the disease must give way and the pain be relieved. In the chronic forms, which have lasted some years, besides the above, the galvanic bath may be used with advantage as an aid; and when there is any muscular paralysis—which is not at all uncommon—the stimulus of the electro-magnetic apparatus localized in the affected muscles will be found of the greatest possible advantage.

At the College of Dentists, before the Committee called together to report upon the value of electricity as an anæsthetic in dental operations, I had the pleasure, upon two occasions, of demonstrating the power of the continuous galvanic current to allay the pain of tooth-ache, by which means the teeth were saved, so that instead of being extracted they were stopped.

*Case* 9.—A girl suffering with most severe pain in a bicuspid, begged to have the tooth removed; but it being deemed a fair case for the trial of the continuous current, I applied a 60-link Pulvermacher chain battery, the positive pole to the jaw, the negative to the tooth, for five minutes. The passage of the current itself produced slight pain for the

first moment, but that, with the tooth-ache, gradually subsided. She suffered no pain afterwards, and Mr. Hockley was enabled the next day to stop the tooth.

*Case* 10.—Earl C—— had been staying at Wilton, a low marshy neighbourhood; he had also been unfortunately exposed for some time to a draught at a railway station. Upon his return to London he was seized with the most excruciating neuralgic pain in both thighs, almost unbearable, for which everything that medical skill could devise had been tried in vain, such as chloroform and oil liniment, hot poultices, quinine, opium, &c. Upon the recommendation of Sir Charles Locock I was sent for, and immediately applied two 40-link Pulvermacher chains from the loins to the thighs, direct current. Before I left the room Earl C—— expressed himself relieved; and after a tolerably comfortable night he awoke free from pain. The chains were re-excited the next morning, and he returned to the country. I had the pleasure of meeting his lordship at a railway station three months afterwards, and he told me he had had no return of his very painful attack. Through the kind recommendation of Earl C—— I also had the pleasure of relieving

*Case* 11.—The Countess de F——. This lady had suffered for a very considerable time from painful neuralgia of the forehead and face, following the course of the sentient nerves. She could obtain no permanent relief from medicines, although she found an occasional dose of calomel to be of service. I applied a 40-link chain from the nape of

the neck, with the aid of different sized and shaped conductors, to the painful spots, direct current, with speedy relief; it also, oddly enough, produced a discharge of bile by vomiting; this is a singular circumstance, showing the manner of action of the calomel. I consider this a very instructive case.

*Case* 12.—Mrs. R. L—— had been for some time in bed on account of some affection of the ovary, when she was seized with a neuralgia of the head extending from ear to ear, of such an excruciating character, that she could neither bear light nor sound; chloroform, opium, conium, &c. afforded her no permanent relief; when she was advised by Sir Charles Locock, her physician, to apply to me. Upon the application of a 60-link Pulvermacher battery, from the nape of the neck to the painful part, direct current, she was enabled within half an hour to bear the curtains drawn, and to hold a conversation with me in the natural tone of voice; another remarkable circumstance was, that before the application of the galvanic current her pulse had been small and quick, and her extremities cold; after the operation her pulse was soft, of a good volume, and 70 to the minute, and her skin of a nice warm temperature.

These are a few of almost numberless cases of rapid and permanent relief of neuralgia by the aid of the continuous galvanic current. In fact, I can distinctly state that I have never yet had one case of neuralgia that

I have failed to relieve, and only one case that I have not cured. In sciatica it acts like a charm, and in every form of neuralgic pain wherever it may occur.

Duchenne has recommended for several forms of neuralgia, Faradisation of the skin of the most painful character; and he treats sciatica, &c. by applying sudden and acute shocks to very sensitive parts, such as the helix of the ear, or the nasal septum. Briquet, also, in a paper published in the "Medical Times and Gazette," Nov. 27th, 1858, winds up an interesting communication upon "Hysterical Muscular Hyperæsthesia," by saying, "The means, *par excellence*, is the Faradisation of the skin as performed by M. Duchenne. By his apparatus the electrical current is limited to the skin, its passage being accompanied by a series of sparks corresponding to the zinc pole. The pain these sparks produce is so severe as not to be bearable beyond a very few minutes. The hyperæsthesia is usually at once dissipated, and when this is the case, even firm pressure, or movements of various kinds, fail to induce any pain. Not unfrequently a single application suffices, but sometimes the pains return at the end of an hour, but more commonly after five or six hours; if they have not returned by this last period we may be certain that the cure is definitive. When they do return the application must be repeated, they becoming feebler after each.

"If, however, after two or three *séances*, success has not attended them, the application must be renounced.

The conditions for success of Faradisation are the recent date, the diffusion, superficial seat, and moderate intensity of the pain. Still, as there are cases in which, though the pain has been of old date, success has taken place, it may almost always be tried with some chance of benefit. As a general rule, hysterical women bear Faradisation with far more courage than men: but some of them are so susceptible that its employment may even induce paroxysms of hysteria. In such cases chloroform must be previously inhaled, as it should be also in those cases in which from the intensity and extent of the myosalgia the patient may not be expected to be able to bear the Faradisation during the time necessary for its relief. The chloroform in no wise impedes the revulsive action of the Faradisation. Still Faradisation is a means we should not have recourse to until the others have failed, or when the pain is so slight that a current of small intensity will suffice for its dissipation. During the treatment of this affection, the repose of the hyperæsthetic muscles is of prime necessity, and in some cases has sufficed alone for a cure. In ignorance of the nature of the affection, and when the pains have been believed to be located in the splanchnic viscera, exercises of various kinds have been recommended. Absolute repose is essential, and a few days of such sometimes suffices to relieve pains that have resisted various energetic remedies.

It is to be understood that the local treatment of these

myosalgias is but the complement of the general treatment which is the basis of management of cases of hysteria."—*Union Médicale*, Nos. 21, 27, 30, 36, 41.

Now, by the continuous galvanic current all that M. Briquet claims for Faradisation may be attained without the slightest pain; how much more preferable, therefore, must the continuous current be to Faradisation of the skin in nervous and susceptible patients?

## MUSCULAR CONTRACTIONS, RESULTING IN DEFORMITY.

We hear much of various operations by Orthopædic surgeons for deformities; Tenotomy, Talipes varus, equinus, and valgus, are household words; but are they successful? I believe not; many cases that I know, and have come under my treatment afterwards, have derived no benefit from the operation, and the reason I believe to be as follows:—

Club-foot—and I will here quote Mr. Skey's definition, as it is excellent and much to the point,—"or talipes, is the result of a morbid condition of one or more of the muscles moving the foot, whether in flexion, extension, adduction, or abduction. It owes its existence to any cause which may interfere with the sufficient supply of nervous influence, or arrest the current of nutrition to the muscles. This may be produced by a local, a con-

stitutional, or a general cause. An attack of fever in a young person may be followed by loss of power of one or more muscles. The spine may be injured, or the spinal centre of the nervous system, as in the process of dentition, may be the seat of irritation: long confinement, repeated attacks of muscular rheumatism, local violence to muscles, each and all are sufficient to produce it." In fact, it is a paralysis of a certain muscle, or a certain set of muscles. Now, we know that the muscular system of the body is arranged on a beautiful system of equilibrium—the flexors are counteracted by the extensors, and so on; if a flexor contracts, the antagonistic extensor yields; the consequence is, that in these partial paralyses, where one set of muscles are paralyzed, the healthy antagonistic muscles eventually contract. Then, in other cases, contraction of a muscle, or muscles, constitutes the disease; of this I have seen several instances, and it is far easier to treat.

My method of treatment for these cases is as follows, and is simplicity itself. To those muscles that are *contracted*, I apply the continuous galvanic current until they yield; to those that are paralyzed and flaccid I apply the interrupted current and rouse them to contraction. I protest that in recent cases, this will cure in a short time, and that in the most inveterate a cure will eventually take place, if the ligaments are not absorbed. One case, in which the hand was fearfully contracted, baffled me on account of

total absence of the lateral ligament, the effects of severe hemiplegia of twelve years' standing, following scarlet fever.

Slight curvatures of the spine, so common amongst young ladies, arising from debility of a muscle or muscles, caused either by badly-made stays or some awkward position, the result of habit, are rapidly cured by stimulating the debilitated and relaxed muscles by the interrupted current; the usual custom of lying upon the back generally increases the curvature, by increased relaxation of muscular tone. The same may be said of steel instruments, which, by removing the weight of the body from a certain set of muscles, decrease their natural tonicity and weaken the patient. I have now for some years completely set my face against these appliances, as being more likely to increase than diminish deformities. Well-regulated gymnastics are admirable adjuncts to the electro-magnetic stimulus.

### Stiff Joints.

This complaint may arise from causes too numerous to mention, and it is not my intention to enter at all upon the pathology of the disease, but illustrate with a few cases the method of treatment by galvanism.

*Case* 13.—Mrs. W.—Stiff right knee, with œdema of the leg, after childbirth; had been so for ten months; had derived very little benefit from treatment; knee painful, and very much swollen, so as to have lost the form of the

joint altogether; no inflammation, but evidently fluid within the joint; treatment, a 25-link Pulvermacher chain bound round the knee, direct current; after the first week, gentle motion to be encouraged by an india-rubber strap and stirrup, and the debilitated muscles caused to contract by the electro-magnetic apparatus. At the end of one month the knee had completely regained its form, there was no fluid within the joint, she could straighten her leg in bed, stand upon it, and walk a few steps, and all without pain.

*Case* 14.—I. L——, Esq., M.P.—Stiff knee. This gentleman, when a young man, had had the misfortune to dislocate the tibia from the femur, terminating in a stiff knee; he, however, was enabled to ride on horseback. Some years ago, whilst hunting, his horse had fallen upon the same (left) leg, fracturing the tibia, and very much injuring the ankle; being placed in splints, and lying up for many weeks, caused increased stiffness of the knee, so that upon recovery from the fracture he found that he was unable to ride, from the immobility of the knee; from my success with Sir I. D. D—— I was called in to Mr. L——. There was much wasting of the muscles of the left thigh and buttock, with almost total immobility of the knee joint, swelling of the leg, with extensive discoloration from old bruises on the ankle and foot.

*Treatment.*—Five Pulvermacher chain bands from the spine to the inner ankle, direct current; daily stimulus

to the wasted muscles of the thigh and buttock, with the electro-magnetic apparatus localised in each muscle; at the end of a week the swelling of the leg had very much diminished, and the discoloration almost disappeared; the muscles of the thigh answered to the stimulus, and were contracting more naturally; he was enabled slightly to move the knee, there being some little ginglymoid motion; he was altogether more comfortable and easy. In fifteen days, when he was obliged to leave for the country, he had completely regained the use of the muscles controlling the motion of the knee, so that he was as well as before the last accident. He stated, that on his return to London he should continue the treatment, hoping to gain more use of the leg even than he had.

### Œdema of the Legs,

From fracture, or after rheumatism, or gout, with long confinement; even after a cure has taken place, frequently prevents the patient from making use of the leg, eventually leading to almost complete paralysis of the limb. The leg is swollen, puffy, and shining, with a sodden, dead, heavy feeling; if this is not remedied the muscles degenerate, becoming converted into fatty tissue.

*Case* 15.—Admiral Sir I. D. D——, 74 years of age, had, when a midshipman, fractured his left leg in a most

shocking manner by the recoil of a gun, in fact, it was so severe as to cause a consultation of surgeons, to consider whether it was advisable to remove the limb or endeavour to save it; eventually, his youth was considered in his favour, and the limb was saved, and turned out, although rather unshapely, a very serviceable member. During the Crimean War Sir I. D. D—— was in command of the Black Sea fleet, and what with anxiety and exposure he suffered with fever, from which he however eventually recovered, with the exception of the leg which was so weakened, swollen, painful and puffy, that he could neither walk nor ride, and, in fact, feared he should lose the use of it. When I was consulted, he could just move with the aid of two crutches. I applied round the limb three chain bands, and daily stimulated the relaxed muscles with the aid of electro-magnetism. In twelve days the œdema had been entirely removed, and Sir I., with the aid of a single stick, walked a quarter of a mile, with ease and comfort.

*Case* 16.—The Right Honourable E. E——, 73, gouty contraction of the gluteus maximus of the left side, and of the biceps of both thighs. These muscles were hard and tense, and caused great inconvenience in walking, with occasional pain. Health otherwise excellent. This gentleman, a distinguished statesman, had led a most useful and active life, and it was inconvenient to him, as a member of the House of Commons, to feel a difficulty

and consequent disinclination to walk; he therefore applied to me to relieve him.

*Treatment.*—Two Pulvermacher chain bands from the base of the spine, crossing the gluteus maximus, down the biceps terminating at its insertion, each side alike; direct current. Daily, for three quarters of an hour, the stimulus of the electro-magnetic apparatus, localised in the affected muscles whilst relaxed. Under this treatment, in a few days all pain had disappeared, and the contracted muscles gradually gave way; in ten days he left town for his seat in Scotland, completely recovered, stating, that upon any future occasion he should most decidedly avail himself of the galvanic current.

## Hysteria

May and does imitate every symptom of a disease so exactly, as to deceive many; there are, however, some few symptoms which are peculiar to Hysteria, and which are not present in the disease imitated. Sydenham writes as follows:—

"Falling upon one or other of the kidneys, hysteria may cause the acute and intense pains of nephritis; pains not only simple and confined to the region of the kidneys, but accompanied with vomitings and pains along the ureters. Then, the diagnosis is difficult. It may be hysteria, or it may be a calculus, and unless there have been some antecedent mental emotion, or else the aforesaid porraceous

vomitings (the matter brought up is green, bilious, and like, as they say, *leeks;* sometimes of a still more unhealthy colour), the former may be mistaken for the latter. The bladder, too, may help in the deception; since pain may be present and the urine may be suppressed. All this is just as if there were a calculus. No calculus, however, may exist. Of the two forms, the one imitating inflammation of the kidneys, and the other, like a stone in the bladder, the latter is the rarer. Each, however, is commonest in such females as have suffered repeated shocks, and been weakened proportionately."

How extraordinary is this imitation; every symptom of true functional, or even organic disease, photographed, as it were, upon the nervous system, soon to be wiped out, perhaps only to afford a medium for a fresh impression; but although the picture may be very exact, even to the minutest line, yet there is always something, however small it may be, to be detected by the eye of the artist, whereby the counterfeit may be distinguished from the original. First, the urine in hysteria is, during the attacks, copious, limpid, and of low specific gravity; in the intermissions it may be natural, generally however pale, passed in larger quantities than in health, of slight acidity, and soon becoming alkaline; the urine of disease is very different. Secondly, there is always something flighty about the patient's manner, inclined to tears, to sighs, to gapes, to laughter, to great depression of spirits, to rapid

fluctuations of temper, differing diametrically from real disease. Then, again, there is the history, leading us to the suspicion of a tendency to hysteria; some blight of the affections, some domestic troubles, some depressing illness, tending to nervous dejection. Whereas, on the other hand, we find a cold caught, an epidemic, or miasmatic influence, a blow, or some actual and not mental depressing power.

### Hysterical Paralysis

Is rapidly and, generally, easily cured by electricity; the pathology of the affection, I have explained in Nervous Affections, being simply a diminution of nerve force in the part, this nerve force is collected in some other organ, which is in an exalted state. The treatment indicated, is to apply to the part an agent which will either draw nerve force to it, or will supply an artificial stimulus in its place; this may be effected either by localised induced currents to the skin or muscles, or by the continuous current of Pulvermacher's chain. I should object to any painful application to the skin, as liable to irritate the already excitable patient; on the whole, I believe the chain, carefully applied, with large moist conductors, is the best and simplest method of treatment; at the same time, proper hygienic and medicinal remedies must be used, otherwise upon relieving one paralyzed limb

by galvanism, another may be attacked, and so on. I am also accustomed to apply the chain to the epigastric, hypochondriac, and hypogastric regions, &c., according to circumstances, in hysterical affections.

*Case* 17.—Miss W——. This was a case of deep-seated pain near the left hip-joint, lasting many years, accompanied by shooting pains down the leg, with a sense of pressure upon the lower portion of the spine; there was an enlargement in the left hypogastric region, accompanied with great tenderness on pressure; there was general hyperæsthesia of sensation of the left side, with a certain amount of loss of power both in the arm and leg.

Miss W—— had been upon her back for six months, with relief from pain when quiet, but immediate return when taking the slightest exertion. I placed upon her a series of chain bands, inverse current, and also passed through the hypogastric region twice a day, for a quarter of an hour at a time, the direct current of a powerful chain battery; by this means, in the course of six weeks, the constant, deep-seated pain was entirely eradicated, and she was enabled to take daily short, but increasing walks, without pain.

*Case* 18.—Miss E. M——. I have often noticed in hysterical hyperæsthesia, the necessity of making use of the inverse current; the reason for this is difficult to understand, except that in hysteria all our reasoning is frequently of but slight use, the disease baffling the efforts

of the most acute observers to understand its pathology. In this young lady, troubled with pain in the left side, with swelling upon the ribs, the direct current from the spine rather augmented the pain than otherwise; the inverse current soon, however, dispelled both the pain and the swelling.

### Aphonia,

Usually accompanying hysteria, is decidedly one of the most satisfactory affections to treat by galvanism; as a young woman, who has been speaking perhaps for weeks in a whisper, addresses you in from one to five minutes in her natural tone of voice. Fourteen months ago a young woman, recommended to me by Dr. Coote, from the Western General Dispensary, entered my house speaking in a whisper, and in five minutes quitted speaking in her usual way; she has retained her voice ever since. This rapidity of cure is effected by localised induced currents to the larynx, and neighbouring parts.

### Epilepsy.

It is almost impossible to give directions for applying galvanism in epilepsy, the disease being excited by innumerable causes; as, however, the seat of the affection is the cord and brain, induced by abnormal circulation in those organs, I recommend a 60-link Pulvermacher

chain to be worn constantly, the positive pole to the cervical vertebræ, the negative to the epigastrium; other chains may be used at the same time, according to the case. This treatment is to be made use of in the intermittences; if we are called in during a fit, the heart should be stimulated, and the circulation generally, for it is in the arrest of arterial circulation, and the regurgitation of venous blood, in which the affection essentially consists.

I may here state, that the administration of powerful galvanic currents requires much care, and some knowledge and practice, as occasionally by its application in unsuitable cases, or in too great quantity, or tension, highly dangerous conditions may be induced. In one case, I was called in to attend a young lady in a tetanic condition, who had been seized whilst taking a galvanic bath at an establishment for their administration; she did not recover for two days, having suffered much pain and some fright.

### Torpid Liver of Indians.

This troublesome disorder, affecting Europeans who have been for a longer or shorter time in hot climates, and frequently resisting our best efforts and the most approved medicines, I have found yield sometimes immediately to galvanism, as the following case will prove.

*Case* 19.—C. C——, Esq. Torpid liver of two years' standing, after fever and ague in India; on his return to England

could get no benefit; had taken much medicine, plenty of mercury, in fact would not take more; would gladly give galvanism a trial, especially as there was nothing to take. Applied a battery chain to the region of the liver by means of moist conductors: he said, he felt it "work the liver;" this immediately removed the pain, uneasiness, and sense of weight he complained of, and I am happy to say, with the best results, for he was enabled to keep entirely free from all unpleasant symptoms whilst in England six months, and married, returning to India, perfectly confident in being able to keep himself well by aid of the battery chains, with which he returned laden.

I may here say, from many instances which I have observed, that galvanism seems to act more rapidly and with better effect on Europeans returned from India, than on those who have not been to hot climates.

### Asthma,

As might be expected, is rapidly relieved by galvanism; being, pathologically, a spasm of the minute muscular structure of the bronchi, the application of the continuous galvanic current is indicated. The method of application is as follows:—After having excited one or two Pulvermacher bath chains, apply the positive pole, by means of a large moist conductor, to the back of the neck, or, if it can be managed, upon the trunk of the pneumo-gastric nerve

in the neck, between the origin of the sterno-mastoid muscle and the omo-hyoid. The negative pole is to be attached to a large, well-moistened conductor, and passed over the ribs before and behind. This is the method of treatment during the attack, and will relieve in from five minutes to half an hour. To prevent an attack, two chain bands should be worn during the day, from the back of the neck to beneath the nipples on either side; direct current.

Dr. Wilson Philip, an able and far-seeing physician, thus wrote upon the treatment of asthma by galvanism:—"I have employed galvanism in many cases of asthma, and almost uniformly with relief. The time during which the galvanism was applied before the patient said his breathing was easier, has varied from five minutes to a quarter of an hour; the cough, under its use, generally becomes less frequent, in proportion as the accumulation of phlegm in the lungs is prevented. It is remarkable, that in several who had laboured under asthmatic breathing for ten or twenty years, it gave relief quite as readily as in more recent cases. The permanency of the good effects of galvanism in the disease before us, has appeared very remarkable."

The interrupted current is not applicable to the treatment of asthma, although it has been recommended; but where we have so certain and easily-applied apparatus as the continuous, few would venture upon the more complicated, current of electro-magnetism.

*Case* 20.—Mrs. W——. This lady suffered severely from asthmatic attacks, but only in some situations; when she lived in a warm, damp district, she was perfectly free from them, but upon leaving for a visit, or to come to London, she was invariably attacked. The only relief on those occasions, and that only temporary, was to stand with her back close to a hot fire: reasoning upon this, and knowing the calorific effect of the continuous current, I applied the current with a metallic conductor to the skin of the back, with speedy benefit; and recommending the use of the chain bands when from home, I had the gratification to hear that there had been no return on her next absence.

### Amenorrhœa

May arise from many causes; it is, however, generally a disease accompanying a debilitated state of the constitution. With the aid of galvanism it is usually very tractable. When a young girl has arrived at an age when menstruation should appear, and it does not, and this condition is accompanied by great debility, lassitude, flying pains, and other symptoms peculiar to this state, it is necessary to induce the flow, previously however by diet regimen and tonics, to place the patient in the best possible condition for the change.

I shall not here bring forward any cases in point, but merely indicate the method of treatment found universally

efficacious. Give night and morning a galvanic hip bath, the water containing bay salt, for half an hour, this will increase the circulation in the parts; in mild cases this alone will generally succeed in the course of a fortnight, inducing the menstrual discharge; if so, the bath may be left off for three weeks, and then again commenced, twice daily. If, however, after a fortnight or three weeks, this treatment does not induce the excretion, a current from one or two large chains may be passed through the pelvis from the sacrum to the perineum and pudenda, with moistened conductors, for a quarter to half an hour; this, with the proviso set forth by Dr. Golding Bird in the quotation below, never fails. "In galvanism we possess the only real direct emmenagogue with which the experience of our profession has furnished us. I do not think I have ever known it fail to excite menstruation where the uterus was capable of performing that function."

### Dysmenorrhœa.

Painful menstruation may be relieved in the same manner as the previously spoken of malady, especially when it has a neuralgic tendency; if the galvanic bath contain sulphur instead of salt it will assist in the cure. The more complicated methods of applying galvanism to the womb for this affection, for sterility, and some other allied disorders, I hardly feel myself justified in entering upon in a pamphlet

of this description; they will be found in another work. *Suppression of the secretion of milk* has been successfully combated by M. A. Becquerel, and re-induced by electricity.

## Spinal Irritation.

This name is given to a series of cases of deep importance, and of the greatest interest to the thoughtful physician, for the same series of symptoms may arise from almost any cause, however different in their nature. Irritability of the spinal marrow is evinced in cramps of muscles, spasms, painful spots; a portion of skin may appear scalding, or itching, and to such an intolerable degree, as to cause the sufferer to roll on the ground, and scream with the intensity of the irritation; a portion of skin may feel raw, or ulcerated, or a continual gnawing may be experienced.

I knew one patient who was to all intents paralyzed from irritability of the cord, for he could hardly move a muscle in his body voluntarily, and yet they jerked and were cast about in the most fearful and extraordinary manner involuntarily. Pains in the back are complained of—relieved by bending forward, or being rubbed; hypochondriacal or hysterical symptoms are frequently, in fact I may almost say always, connected with this irritability of the cord, and for that reason many physicians assert that it is all fancy; but this is not so; there is always some real disorder of the nervous system which gives rise to these peculiar

symptoms; have talent enough to discover that, and you cure your patient; fail, and you must resort to the assertion "that it is all fancy, caused by a diseased imagination: change of air and scene will cure the case."

Now, I have had too many of these cases not to know that if you can hit upon the right cause, difficult I grant, but still if you can manage to discover the cause of the irritation, the organ that is in fault, then you may rapidly cure the patient; and it is not to the spine or the cord itself that our attention must be turned, but to some remote organ, which, by reflection, is producing these obscure symptoms. As there are as many causes of spinal irritation as there are nerves entering the cord, I can only give a few cases to illustrate the method of diagnosis and treatment; and I must say that it requires the most searching inquiries, and the gravest attention and study, frequently, to discover the hidden cause.

*Case* 21.—The Rev. M. —— This gentleman complained principally of the most severe cramps and scalding sensation in the little and ring-finger of the left hand, and of the outer side of the right leg; coming on at stated intervals of from five to ten minutes, and lasting as many seconds; some days they were very much more severe than others, but never altogether absent;—his life had become a burden. He had procured my work "On Nervous Affections," from which he had obtained many useful hints, particularly as to diet; and had profited by them so much as to be almost cured of his

indigestion, and other extraneous symptoms, but not the cramps. He therefore came up from the country to place himself under my care.

I discovered that he had great difficulty in holding his water; in fact, he frequently was unable to do so; that he had a discharge from the urethra; that, when at College, debility in the genito-urinary organs was shadowed forth. Upon endeavouring to pass an instrument the scalding was so excruciating as to be totally unbearable. I therefore passed it after placing him under chloroform; and this I did ten times when I found that I could pass the instrument without creating much pain. The continuous galvanic current quite removed the cramps, but not affecting the part at fault I was obliged to resort to the urethral instrument as an aid.

In three weeks, with this combined treatment, together with tonics, he had quite recovered, both in health and spirits; and he told me that he had never felt ease for the eight previous years. He now gladly returned to the country.

*Case* 22.—Miss G——. Spasms, very much resembling epilepsy, every month; the head thrown to one side; the body bowed; and semi-stupor, followed by sleep. This affection was connected with periodical irritation of the left ovary.

*Treatment.*—To wear a Pulvermacher chain from spine to ovary; inverse current between the periods; at the time an anodyne draught and injection. This had the desired effect,

and she was, and has remained, perfectly well ever since (three years).

*Case* 23.—Mrs. L. T—— Chronic inflammation of the lining membrane of the uterus and bladder, with spinal irritation transmitted; constant desire to pass water, with bearing down pains; pains down the thigh to the knee; weight and oppression in the loins; frequent bilious attacks, with costiveness; had suffered much, and undergone much treatment with only temporary benefit.

The neck of the uterus had been ulcerated, and had been cauterized frequently, and was healed, but there was a want of elasticity about it that was unnatural. To wear the cervix uteri galvanic plug; a chain from spine to hypogastrium; direct current; and daily to have passed the powerful continuous current from spine to lumbar regions by means of the galvanic bath.

I can hardly say how rapid was the cure in this case. Considering the long-standing irritation, the extreme pain and annoyance undergone, the relief was so marked and immediate, that the patient could hardly believe in her good fortune.

## Nervous Debility,

So called, arises from so many causes, so diverse in their character, that it is impossible here to enter upon them. I may, however, refer to my larger work "On Nervous Affections" for the pathology and treatment of these affec-

tions ; at the same time, I may say, as I did in that work,— "In all the diseases of which I have treated, the tone of the nervous system being lowered, or its equilibrium upset, the stimulus of electricity is valuable. I am accustomed to make use of it, in many cases, as an aid to other treatment. It is a powerful stimulant to the jaded nerves, increasing their irritability, and lending tension to the centres."

Galvanism, judiciously applied, appears to seek out the part or organ affected, and, by supplying the proper stimulus, reinvigorates it, so that it is enabled to perform its normal functions, health resulting.

The brain, which had been previously upset, being filled with fears and dread of impending evil, soon regains its happy tone ; and a weight, which had previously deadened all energy, is lifted off from the patient, who again finds some delight in life beyond the daily routine of duties, which had become irksome from their monotony.

It is remarkable to what an extent a perfectly healthy brain will be affected by impure blood. I can call to mind many cases, some of which I have recorded in "Nervous Affections," in which patients, apparently insane, have been completely cured in a remarkably short time, by directing the treatment to the organ that is really out of order, which, through some actual local functional derangement, has allowed the blood to circulate in an impure state, upsetting other organs, and acting secondarily on the brain. I find the most certain means of detecting the cause of such affections is by a

thorough examination of the urine chemically and microscopically; when the organ in fault can almost always be detected by the deposits discovered, and the correct treatment indicated.

The following is a remarkable instance in point.

*Case* 24.—Miss S. L——, aged 28. Had been for some time in a low desponding state; was of a sallow complexion; very much emaciated; never did any work, but sat with her hands before her, lowly muttering to herself. When spoken to she said, "Forsaken by God," or some such expression: she used to be most excitable in the morning, sometimes screaming loudly, but usually she was quiet. Her brother, with whom she was living in the country, brought her to town, and I saw her, and recommended her removal to an asylum, where she might be treated judiciously; but he would not consent to part with her, and asked if I could do anything for her? I said, certainly; but that it would take time, and much attention. Upon a searching examination I found the liver to be the organ in fault, and to this the treatment was directed, and with most marked success; for almost immediately she revived, and steadily improved, until, in a little more than a month, she returned to the country to follow out my directions at home.

It would take too much space to enter into the details of treatment in a pamphlet; it is sufficient to say that the liver was stimulated by medicine and galvanism; and that the uterine functions, which had been irregular, soon sympathised with

the liver, and returned to a healthy state. The brain, which had been looked upon by the friends as the organ in fault, required no attention, as the patient rallied her spirits, and soon became cheerful, returning to her usual occupations.

## Costiveness.

*Case* 25.—G. W——, Esq. This gentleman had suffered from long-standing costiveness; so much so that he never had a stool without the aid of medicine. His health consequently suffered, and he was weak and debilitated; tongue always furred and dry.

*Treatment.*—All medicine to be given up; diet plain and nutritious, brown bread and porter; daily regular exercise, with cold bathing; to wear a 40-link Pulvermacher chain from spine to the pit of the stomach all day; direct current, excited in the morning. In ten days he was much better; and in a fortnight he had quite recovered the tone of the muscular coats of the bowels. This recovery was permanent, until he left England for France, more than three months afterwards, when I lost sight of him.

*Case* 26.—Mrs. G—— had suffered for many years with extreme costiveness; so much so that an enema was used daily as a regular proceeding, besides continual medicines; she could gain no relief from the many forms of treatment she had resorted to, and hardly expected any from galvanism.

*Treatment.*—Two 40-link Pulvermacher chains; one from the spine to the pit of the stomach, the other from the spine to the left hypogastric region; to be worn all day, and excited every morning; direct current; daily stimulus by the electro-magnetic apparatus to the abdominal muscles. After this treatment she required no more medicines, and had but one more enema. She gradually improved, and, in the course of three weeks, she stated that she had completely recovered her health.

## Deafness,

Arising from no actual disease or structural change, may be cured, or greatly relieved, by electricity. A case I had under my charge did admirably with a short Pulvermacher chain, the conductors being small moistened sponges, inserted in the ears, and worn for several hours at a time; the direction of the current being changed upon the next application.

The following case is of the greatest interest, and very instructive.

*Case* 27.—Miss B——, aged 8 years. Four years ago had the measles; a short time after which she fell into a pond; she was then discovered to be completely deaf, so much so as not to be able to hear the report of a pistol fired behind the head. Mr. Toynbee was consulted, and pronounced it to be an affection of the nerves or brain, and not of the organ itself,

which he considered healthy. She has lost the proper enunciation of words in consequence, singing and clipping her words, &c.

February 24th, 1859.—To wear a 40-link Pulvermacher chain; the positive pole upon the mastoid process of one ear, and the negative with a moistened sponge into the other, for 24 hours; then change the buckle to the opposite process, and the sponge to the other ear; and so on every day. To pass through the head from mastoid to opposite ear, an interrupted current from the secondary wire of the induction battery for a short time every day.

March 14th.—Can hear loud sounds with the aid of an ear-trumpet.

March 24th.—Can hear the piano at the other end of the room, the organ in church, the falling of fire-irons, the postman's knock, and sounds through the trumpet; her speech also is very much improved. She did not advance beyond this for some time; she therefore discontinued treatment for the present, and returned home.

Now many interested in this case declare that these sounds which I say she heard, they say she felt. How, then, is it she did not feel them before the galvanism? for all these experiments had been tried before, hundreds of times, without effect. Her parents also, and those in immediate connexion with her, are persuaded she actually *heard*, and did not feel these sounds or vibrations. I look forward with much interest to the termination of the treatment.

## On Electricity in Dental Surgery.

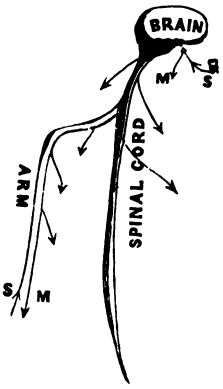
I have already spoken of the method of applying galvanism for the relief of toothache (p. 75), and I shall now proceed to treat of its application in allaying pain during extraction.

Having been present upon every occasion at the College of Dentists when the Committee were considering the value of "Electricity as an Anæsthetic in Dental Operations," and having, besides, had many opportunities of trying the question, I feel that the weight of my opinion on this head must be great; and although the majority of the Committee at the College of Dentists gave an unfavourable report of its value, still, any one who will take the trouble to study the cases, will see that although electricity, however applied upon those occasions, did not produce *true local anæsthesia*, still there was sufficient relief obtained in the majority of cases to afford to a careful operator great hopes of a valuable agent being granted to him.

True local anæsthesia is almost impossible; for even ice, when carefully applied, causes pain and uneasiness to a great extent. Then, again, as long as the brain is active it can always imagine pain; and even when complete anæsthesia has been produced by ice, I have seen the patient undergo agonies of fear lest he should suffer pain: still I must say that ice is a most admirable aid to the surgeon in superficial operations, and I always use it when I can. Any agent that will allay the dread of pain, that will call off the attention of

the patient from the operation, must then be of the greatest value; and electricity is an agent of this description; because it must be remembered that the extraction of a tooth is, in skilful hands, but the work of a second. I am sure that gentlemen, dentists, members of the Committee, with whom I had the pleasure of being associated at the College of Dentists, quite surprised me with the facility with which they extracted the offending grinders.

The following physiological explanation of the effects of the induced interrupted current upon the nervous and muscular systems I forwarded to the "Dental Review" for January, 1859.




S. *Sensational Current.*
M. *Motor Effects.*

The current enters the tooth as a sensational one, and passes at once to the conductor in the hand,—the current being interrupted, a sensational one passes in at the hand to the instrument on the tooth; and so on, to and fro, until the tooth is extracted. Now let us see what takes place.

When the current enters at the tooth it passes to the spinal cord, and is reflected to the muscles of the face and jaw, which contract; this is a physiological phenomenon established by Dr. Marshall Hall; but the current has to pass to the hand, and, in its course through the spinal cord,

excites contraction in the muscles of the chest and arm. The current now entering at the hand, gives rise to a sensation referred to the hand, but is reflected to the muscles of the arm, which contract, and, passing on to the tooth, causes contraction in the muscles of the face, jaw, and neck. These effects have all been beautifully demonstrated by physiologists, as Hall, Matteucci, Dubois Reymond, &c., as the result of the stimulus of the electric current.

We may now easily understand the state of uncertainty under which the brain labours to class the sensations referred to it by the various nerves stimulated by the electric currents. First, there are the nerves of sensation; namely, from the tooth and from the hand; secondly, there are the various muscles which contract by the reflection of the inverse currents, say twenty; and, lastly, there are the muscles which contract by the action of the two direct currents, say forty. As each contraction of a healthy muscle under the stimulus of electricity gives rise to a sensation referred to that muscle, we may well understand the number of sensations, and re-sensations, referred to the brain at each interruption of the circuit, say twenty times a second. The brain is thus completely bewildered with the number of unaccustomed sensations it is called upon to take cognisance of every twentieth part of a second, and with a skilful operator for not more than from one to three seconds.

If a patient be questioned immediately after the operation, before the brain has had time to collect and reason upon the

sensations referred to it, he is at a loss what to say—painful or painless. Where did you feel the pain? he does not know. Arm, neck, jaw, and tooth?—sensations in all.

And this is doubtless the true explanation of the satisfaction the patient experiences. The mind, instead of being fixed upon the one idea of the extraction of the tooth, is engaged upon the whole length of the arm and neck, endeavouring to understand and classify the unwonted and yet not painful sensations produced in them.

We now perceive the nature of the current to employ; it must be sufficient to cause contraction in the muscles of the arm, and yet it must not be painful. As every patient has a different tolerance of the electric current, it is as well to place the conductors of the apparatus in the hands of the patient beforehand, to find the strength best adapted to produce these effects.

When all is prepared for the operation, place a large *moist* conductor in the hand of the patient, then hook on the other wire to the instrument to be used—forceps, key, &c.—a gentle current passing less than the one found sufficient: now fix the instrument on the tooth, and allow the current to pass for a moment; this will give confidence to the patient, and attract his attention to the arm. Now increase the current to the one found best adapted to the patient's feelings, and out with the tooth as quickly as possible. By this method no foot-board is necessary; and, if the operator does not care about the electricity, no non-conductors; if he does,

then the instrument, with the exception of the beak, should be covered with India-rubber. This is the best method of operating.

Now what is to be said of the continuous current? This; that it is a true anæsthetic—but not yet sufficiently understood in its application to be recommended for general use. I have, however, seen several cases in which complete and general anæsthesia has been produced by it. The following, extracted from the Report of the Committee at the College of Dentists, is one in point. See "Dental Review," for July, page 448.

"*Observation* 29.—The patient was a woman. The tooth to be extracted, a lower molar. A Pulvermacher chain of 120 links was used on this occasion. The positive pole was placed externally, attached to conductor with moist sponge behind the ramus of the jaw. The end of the negative pole was attached to the forceps, which was then made gently to grasp the tooth. The current was kept up for fifteen minutes. During the time of the application the woman became drowsy, and relapsed into a kind of hysterical faint. At the end of the fifteen minutes the tooth was extracted.

"*Result.*—The woman on recovery, which was immediate, expressed herself as unconscious of all that had occurred, and was unaware of any painful impression.

"*Present.*—Friday, February 25th, 1859. Drs. Elliotson and Lawrence; Messrs. Harry Lobb, Matthews, Purland,

Kempton, Weiss, Harding, Perkins, Thomson, Williams, and Hockley."

One gentleman present described the phenomena as very much resembling the mesmeric trance.

Besides this case I have had others in private practice, in which the same state has been induced in a like manner; and, through the kindness of Mr. Thomson, a letter from a northern dentist has been placed in my hands, relating an instance in which syncope had been induced by the passage of the continuous current through the tooth for a minute or two. Also in several instances in which the more powerful batteries of Bunsen, Smee, and Daniell had been used at the College of Dentists, syncope was imminent, but this was accompanied by severe pain, and was therefore discontinued. See Observations 26, 27, and 28.

To dentists therefore, as a body, I would not recommend the use of the continuous current, but the induced interrupted. But to gentlemen who will experiment conscientiously, the continuous holds out the reward of a real, safe, and natural anæsthetic. Doubtless, many observations are necessary, and much labour, but the reward will be ample to the successful experimentalist.

# APPENDIX.

In the following Appendix I have massed together observations on the value of electricity as a therapeutic agent, made by many independent observers, at home and abroad, of past times and of the present day; and it affords me much pleasure in being the medium of introducing to the profession several very important and interesting original communications, by gentlemen who are working silently around us, and who, unappealed to, would perhaps bury their valuable experience with them.

I may draw attention to the effects of the electro-magnetic current upon the bladder and rectum, as reported by Mr. Simon, Surgeon to St. Thomas's Hospital, and Medical Officer to the General Board of Health.

Also the case of paraplegia recorded by Dr. Joseph Bullar, of Southampton, a well known and conscientious observer of nature's laws.

Dr. Charles Taylor, Medical Superintendent to the Walton Lodge Asylum, Liverpool, has also most kindly allowed me to publish his valuable and original observations.

Aldini, in his work published in this country in 1803, recommends galvanism as a remedial agent, and gives cases of cure of melancholy madness and deafness; in amaurosis he states that benefit was derived under the galvanic current, but none under electricity.

M. P. Sue, Ainé, in his "Histoire du Galvanisme," Paris, 1805, gives so many, and such remarkable cures with the

aid of galvanism, that it is extraordinary to me how so valuable a remedy could have fallen into oblivion: success must to a great extent depend upon the operator, as otherwise it could not have done so.

As the opinions of impartial, uninterested observers, are always of extreme value in giving weight to your own, I have pleasure in extracting the following excellent cases recorded by Dr. Buxton in the twenty-fourth volume of the Medical Times and Gazette, page 311. Dr. Buxton prefaces his cases by a few remarks upon apparatus, which are unnecessary here. He concludes, by stating those diseases which are most amenable to treatment; and, as I fully concur in the method of treatment he recommends (except in one or two instances, I should have used the continuous current instead, or at the same time as the electro-magnetic), I shall insert them as they stand.

"The complaints in which I have found electro-magnetism useful, are those characterised by local torpidity of nervous action not arising from organic disease. Instances of this kind are amenorrhœa suppressionis, paralysis e plumbo, partial paralysis consequent on rheumatism or other enfeebling diseases, or resulting from a strain or other local injury, some cases of indigestion, with their consequences, as tic doloreux, and some instances of asthma. In some cases in which we cannot suppose nervous action to be deficient, but rather abnormal, or in excess, it alters it, so as to subdue pain. By its stimulating powers it also produces resolution of some indolent tumours, and has been of use in chronic varix.

"I am inclined to the opinion, however, that asthma is more readily subdued by galvanism than by electro-magnetism; at any rate, I cannot lay claim to much success for the latter in the cases which have come under my care.

### Paralysis of the Arms from Rheumatism.

"I.—James Latten, aged 45, cook to a sea-captain.

"September 21st, 1844.—He arrived in England in the middle of last June, after a ten-weeks' voyage. During

this time he was exposed to much inclement weather, which brought on a sharp attack of rheumatism, so that he was confined to his bed the greater part of the voyage. He is now suffering from shortness of breath, general debility, partial paralysis of the arms, with much pain, especially at nights, and attributes these complaints to a severe course of salivation which he underwent on board ship. Since he landed he has been an out-patient at St. Bartholomew's Hospital, where he was ordered blisters to the nape of the neck and upper arms, and not finding himself improving rapidly, obtained other advice, and was ordered small doses of strychnine during a whole month; this proved of some service, both in relieving the pains and paralysis, and he was then recommended to be galvanised. At this time he felt low-spirited, nervous, and unable to use his limbs freely: appeared thin, and the arms, but especially the hands and muscles of the thumb, were much shrunk. The electro-magnetic current was passed through the hands and arms pretty strongly for ten minutes. To leave off all medicine.

"September 23d.—The hands feel somewhat stronger, and the nocturnal pains in the arms have been less. Repeat the electro-magnetism for a quarter of an hour daily.

"September 25th.—Has had no pains in the arms since the 23d, and feels stronger.

"Up to the end of October he attended regularly, being operated upon from twenty to thirty minutes daily.

"November 28th.—Has come occasionally this month, and now feels nearly as well as before his illness. The hands and arms have steadily improved from the first, and are very much fuller, although not quite so strong as formerly. He has entirely lost the nervousness and depression of spirits.

"August 8th, 1845.—Arms still are rather weak; in other respects he has been quite well."

"II.—William Eaton, aged 35, ship-musician, and healthy in appearance, was a messmate of Latten's, and his case was in almost every respect similar, having been taken ill with the same disease at the same time, and

been treated, both on board and since landing, in the same way; he had not suffered so severely; his hands were less shrunk, and he was not so reduced. The patients always came together, but Eaton improved most rapidly, and left off the treatment about the beginning of December, 1844, at the same time as Latten, being perfectly well, and on the 8th of August, 1845, he could amuse in taverns with his fiddle as well as formerly."

"III.—Mr. Riordan, Ship Tavern, Saffron Hill, of middle age, and healthy appearance.

"September 6th, 1845.—About a year ago he had an attack of rheumatism, lasting six weeks, and from which he gradually recovered, but the pains settled in the left hand and wrist. A month ago the muscles of the ball of the thumb were much shrunk; he complained of considerable pain in the arm, especially at night and in the morning, and could use that thumb and the forefinger but very imperfectly.

"He was subjected to the action of the coil, from the nape of the neck to the hand, five or six times last month, for twenty minutes each time. It quite removed the pain: the muscles have nearly regained their natural size, and he can use the hand as well as formerly."

### Muscular Debility Consequent on Rheumatism.

"IV.—Mrs. Page, of 61, Provost Street, City Road, aged 40, married, and mother of nine children. Is of spare and enfeebled habit.

"About ten years ago she became much heated from quick walking on a cold evening in December, and was then kept waiting outside her house for a quarter of an hour, which chilled her, and caused shiverings, followed the next morning by stiffness in the limbs, with swelling and great pain. This was the commencement of a rheumatic attack, which lasted four months, and left her very weak. Three years ago, soon after the birth of her last child, she again took cold, suffered from erysipelas of the face; the limbs afterwards became affected, and have been gradually getting worse since. The

hips, and especially the loins, feel powerless; she has pains in the legs continually, and a sensation of numbness and debility extending even to the ankles; in other respects her health appears pretty good, digestion and the uterine functions being regularly performed, and the sleep undisturbed.

"September 22d, 1845.—Was subjected for twenty minutes to the action of the helix, the current being passed from the nucha to the feet.

"September 24th.—After her visit she walked home with much less difficulty than she had in coming hither, and continues to feel decidedly better.

"October 20th.—Has been attending about every second or third day, and is better, but still has soreness in the limbs. She has now and then had a slight relapse from over-exertion, or exposure to the weather.

"January 13th, 1846.—Has attended once or twice a week, and been steadily improving. She has lost the pain in the loins, and weakness and soreness of the limbs and ankles; can walk further than during the last three years, and, except a little stiffness in the limbs, feels quite well."

### Partial Paraplegia from Disease of Bladder and Urethra.

"V.—M. P——, a tailor, of spare habit and worn by disease, of about 45 years of age, came under my care on the 16th of August, 1844. Three years ago he became troubled with difficulty in passing water, could not always void it when he felt inclination, and it often came only drop by drop. He had also pain and a feeling of weakness in the back, which has gradually increased. Bougies and catheters have been employed about every three or four days during the greater part of the last two years, and aperients, alteratives, and tonics of various kinds resorted to, but without benefit. He is now subject to frequent attacks of retention of urine; the loins and lower extremities are exceedingly weak and painful; he finds great difficulty in walking, and stoops much, being unable to stand erect. For the last eight months he has

passed flexible catheters for himself every three or four days, and has been improving; for before this the left leg was drawn up towards the abdomen, and the knee bent. The urethra also is in a healthier condition, though a stricture may be easily discovered in the membranous portion by examination with a bougie.

"Up to the 4th of September I electrified him, by insulating him, and exposing him to slight continuous electric shocks from a medical bottle (small Leyden jar) and by taking sparks along the course of the sciatic nerves. He continued the use of the flexible catheter once or twice a week.

"In three or four days the stiffness, weakness, and pains in the loins and legs were much diminished; he was less languid, and the freshness always experienced after the process lasted the whole of the day.

"About this time he took cold, with catarrh, from exposure to damp weather, which caused a slight relapse, though the unfavourable symptoms soon disappeared.

"On the 5th of September, the weather being very damp, I used the electro-magnetic apparatus, directing the current from the loins to the feet, and repeated this about every second or third day to the end of the month, for twenty or twenty-five minutes each time, sometimes applying the one pole to the hands, and the other to the abdomen or feet, as it seemed requisite.

"The bowels during this treatment became quite regular, though they had not been so for months previously; the pains left him, his general strength rapidly increased, and he regained his power over his limbs so as to be able to follow his occupation with comfort. He passed the catheter but once a fortnight at that time, and at the commencement of this year continued to be able to walk two or three miles without inconvenience, enjoyed tolerable health, and was free from pain in the loins, except occasionally, if he over-exerts himself or takes cold."

"VI.—Miss ——, aged twenty-five. Has never enjoyed sound health, having always been subject to costiveness since her childhood, and a weight at the scrobiculus cordis after eating.

"About six years ago she began to suffer from pain in the temples, particularly in the left side, which soon became extremely severe, coming on every two or three hours, especially at night, on getting warm in bed; and if left to take its course it usually lasted till early the next morning. She sometimes obtained a week's or even a fortnight's freedom from pain, but seldom more. She had had the best advice that could be obtained in the country, and had undergone protracted courses of aperient medicines, tonics, specifics, sedatives, &c.,—including bark, quinine, arsenic, and steel,—but never with more than very temporary benefit. About a year ago she was severely salivated, and the pain left the left temple, but soon located itself in the right. Previously to the salivation her appetite was irregular, but she has not had any appetite since, and loathes meat and other kinds of food, and constantly has much weight and oppression at the epigastrium, more particularly after meals.

"The bowels are very costive, and she has been for years in the constant habit of taking aperient medicines two or three times a week; either salts, quack pills, magnesia, castor oil, &c. Tongue clean; skin natural; sleeps well, except when in pain; catamenia regular, but accompanied with much pain in the back.

"When an attack comes on she has recourse to a dose of laudanum, back drop, or morphia, which lulls the pain, but produces the usual unpleasant symptoms of stupor, headache, and nausea.

"Having heard in the country of the application of galvanism, she came to town with the express purpose of trying it; and its daily employment during a week for twenty

minutes and half an hour passed through the body, from between the shoulders to the epigastrium, completely removed the pain. During a second week's trial, however, the pain came on in the temple as severely as ever, and she sent to request me to see her, that she might have some anodyne. She had morph. acet. gr. $\frac{2}{3}$, statim sumend.

"On inquiring into her case I ascertained that she had received no instructions as to diet: was still using her usual aperient medicines, and considerably transgressed the dietetic rules suitable to dyspeptics. I therefore forbade her various indigestible articles of food, interdicted the medicine, and strongly recommended her to persevere in the treatment she had begun, with attention to regimen, exercise, regular habits, &c.

"December 2d, 1844. I applied the electro-magnetic apparatus to the nape of the neck and abdomen, in the same way as mentioned in Mrs. H.'s case, only keeping it rather longer to the epigastrium, and directed her to repeat it daily.

"December 9th. Till yesterday the bowels have been moved daily, but in the evening she found the pain beginning, and it increased as usual till the morphia was resorted to. The bowels have been opened this afternoon, and she is free from pain.

"December 16th. Took cold from sitting in a draught, and had a return of her pain yesterday.

"December 26th. Has felt remarkably light and well till to-day, having lost the uneasiness at the pit of the stomach, enjoying her meals, and been tolerably free from pain; but, owing to exposure to the damp weather, had a slight attack yesterday. She dreads the winter as the period in which she has most torture.

"After this time she went home, and pursued the treatment there with so much success that, in February, she wrote to say she was in really good health, and had had no return whatever of suffering since leaving London; that the constipation of the bowels and indifferent appetite had quite left her; and that she had discontinued the treatment for two

or three weeks without experiencing any relapse. In June I heard that she had had a slight return, owing to a severe cold, but that it had subsided under the plan of treatment pursued while in London."

## Neuralgia.

"VII.—Captain S., a stout, ruddy, middle-aged man, of sanguine temperament, in the merchant service, came to inquire if galvanism would be of service in his case. In the spring of 1842 he was at sea for forty days, exposed to very inclement weather, and drenching wet; and subsequently experienced a gradual prostration of strength and loss of appetite, and on reaching Liverpool was so ill that the medical men despaired of his recovery. They ordered him, when a little better, to go to Scarborough, his native place, for change of air, and he there somewhat improved, but became subject to cramps in the legs, from the ankles upwards, seizing him at all periods of the day. For these, after the failure of other means, he was blistered from the nucha to the sacrum, and the sore kept open with ung. sabinæ, by which plan he was somewhat relieved, but his strength again completely failed. Liq. potassæ arsenitis, in very large doses, was administered, and gave a little temporary relief, and another blister was ordered, and kept open. Afterwards the liq. potassæ arsenitis was again given, with the same results as formerly. In this way he has suffered till now, slowly mending however, and enjoying some ease during the late fine weather; but on any exposure to cold or damp, experiencing a severe recurrence of the pains, which are not limited to the lower extremities, but also attack the loins, muscles of the back, and arms, but are not accompanied with any swelling or redness. The remedy from which he has obtained most relief has been mustard poultices, freely applied to the painful parts. The appetite is tolerable; the bowels rather costive.

"September 19th, 1844. Received a pretty strong current

from the helix for a quarter of an hour, from the hands to the feet, passing consequently through all the parts that have suffered.

"December 20th and 21st. Repeated for twenty minutes.

"December 22d. Had a sharp attack of the pains, owing to the cold easterly wind which has set in. He used mustard poultices to the legs and loins, which have somewhat relieved him. In the afternoon I saw him in bed, and employed the electro-magnetism, as before, for a quarter of an hour; the pains ceased immediately. I then passed the electric stream along the spine for about ten minutes.

"December 23d. Was quite eased by the operation, but has had some pain to-day, and feels low. Repeat the treatment daily. At the end of a week he was quite well, and left off coming; and notwithstanding much exposure to the weather, and the prevalence of north-east winds soon after, he had, during the winter and subsequently, but one or two slight attacks of his complaint."

In the year 1851 Dr. Tilt read a paper before the Medical Society of London upon the galvanic cataplasms of Professor Recamier. These are composed of alternate plates of zinc and copper, enveloped in flannel, and are far inferior to the Pulvermacher chain in neatness, uniformity of action, and durability, but, as the effects are identical, I cannot do better than relate the cases in which Professor Recamier found them beneficial:—

"It once brought on menstruation before the usual time, and he therefore intentionally applied it for that purpose, and with success, in cases of chlorotic amenorrhœa. Professor Recamier is also trying it in such cases of sterility as cannot be accounted for by any disease, but which seem to depend on defective ovarian action; and, among other cases, on an illustrious lady whose barrenness menaces to extinguish one of the oldest dynasties of Europe; as well as on a Russian princess, also anxious for a family, in whom the first effect produced was, that menstruation, which formerly lasted but thirty-six hours, was prolonged to six days; but whether sterility will be cured by it, time alone

can show. Dr. Tilt is of opinion that it might be useful in curing some of those tedious cases of chlorosis, where a girl eats heartily, takes plenty of sleep and exercise, has nothing on her mind, but still derives but little benefit from either food or treatment. Dr. Tilt added, that Professor Recamier has used these galvanic cataplasms with marked success in the treatment of rheumatic and nervous pains, in a case of obstinate constipation, in asthma; and a patient suffering from angina pectoris was benefited, but not cured, by their application. Dr. Massé and several other medical men in Paris find them successful in similar cases, as is detailed in the pamphlet Dr. Tilt begged to offer to the Society; and in conclusion, he said that he had only stated the results obtained by his venerable teacher: 'From what I have seen, I am fully convinced, that if a feeble current were kept up for a long time, in certain forms of paralysis (care being taken that the positive fluid traverses the limb in the direction of the nerves), it would prove the most important mode of applying the remedy with success.'"

The following cases, related by MM. Roggo, Manigrassi and Perzutti, are also examples of the effects produced upon the organism by the simple continuous galvanic current generated by a single pair of plates, and bear out my views of the extraordinary alterative action of galvanism upon the nervous and circulatory systems:—

"A physician, 52 years of age, originally of sanguine temperament, but, in consequence of frequent illness, become lymphatic, had a scirrhous tumour of long standing near the inferior left rib. It had become adherent to the adjacent parts, causing lancinating pains on the corresponding side of the chest, and there was difficulty of lying down on this side. After various means had been employed without success, so that he was on the point of having it extirpated, he determined to try electricity. A galvanic pair of proportionate dimensions was applied to the tumour, and after four days its size was diminished, the adhesions destroyed, and the pains ceased. The patient shortly afterwards was entirely freed from his disease.

"A child, eight years of age, had a strumous enlargement of the submaxillary gland, which was painful and adherent to the corresponding ramus of the lower jaw. It was totally cured in two months, by the same means employed as in the case of the physician.

"A man, forty-five years of age, had, in consequence of hypertrophy of the liver and spleen, an old obstruction of the mesenteric glands, with disturbance of the digestive functions. He was cured by the same treatment, after three months' perseverance.

"A patient, fifty years of age, was affected with a venereal eruption, which was attended with pain of the lower extremities; he had also a large node. Warm baths, mercurial fumigations, and many other means, were employed without success. The galvanic couple was then applied. Five days afterwards all the morbid symptoms were relieved, the node had diminished one half, and had become mobile on every side. It continued to decrease, and when the report was closed the patient was nearly cured."

### On the use of Galvanism in Obstetric Practice.

Galvanism has been but little used in this department of medical science; but as I believe it will be found eventually to be of the greatest possible advantage to the obstetrician, I must draw the attention of the profession to its value. I believe some years ago Dr. Ramsbotham threw out some hints that galvanism might be of advantage in inertia uteri, but I do not know that he practically carried out his ideas. Dr. Radford, of Manchester, however, made use of galvanism as a stimulant to the uterus with considerable success, and he was followed by others. The reason, however, that this method fell into disuse I believe was from their making use of the electro-magnetic apparatus, this not being adapted to an organic muscle which contracts slowly and regularly. Dr. Mackenzie, however, in an interesting paper read before the Medico-Chirurgical Society last year, has struck out the right path, and has placed in the hands of the obstetrician a

powerful agent, easily applied with the best effects, and impossible to be hurtful—the continuous galvanic current. I cannot do better than make a few extracts from Dr. Mackenzie's paper :—

"It is necessary, in investigating the value of galvanism as a remedial agent to the gravid uterus, to consider two questions of a preliminary nature :

"1. The nature of the influence exercised by it upon the contractile structure of the gravid uterus; and 2. The best mode of applying it so as to obtain the full benefit of such influence. Believing that these questions could not be satisfactorily solved by observations made exclusively upon the human female, the author had planned and instituted some experiments upon the gravid uterus of the lower animals, in which the organ was exposed, and the exact influence exercised by it was observed. From these experiments it was shown that galvanism exercises a remarkable and peculiar influence upon the uterine fibre; and it further appeared, after many observations, that this was most powerfully exercised when the galvanic current was directed longitudinally through the uterus from the upper portion of the spinal cord in a sustained and continuous manner. The local application of galvanism to the uterus was less effective; individual shocks produced no appreciable effect upon it, and a current directed transversely through the organ produced only a partial contraction of it in the direction of the current. Guided by the information thus obtained, the author had employed galvanism in the manner suggested by these inquiries in several very critical cases with remarkable success. The first referred to was that of a lady who had had repeated floodings in connexion with an early abortion, owing to an imperfect separation and expulsion of the ovum. In this every available means had been tried to stimulate the uterus and control hæmorrhage without success, and the patient's condition had at length become highly critical. In this emergency, a sustained galvanic current was directed longitudinally through the uterus from the upper portion of the spinal cord, and under its influence

the cervix uteri became relaxed, and expanded after the first application, and uterine action set in after the second, which was followed by the expulsion of an organised membrane, upon which the hæmorrhage ceased, and the patient rapidly recovered. The second was a case of placenta prævia, in which several alarming hæmorrhages had occurred before labour had commenced. In this a sustained current, applied in the manner stated for six hours, not only prevented any further hæmorrhage, but so accelerated the dilatation of the os uteri, that the hand was readily introduced, and delivery completed with safety to the patient, although the child, from the extensive separation of the placenta, was stillborn. In a third, excessive hæmorrhage had occurred in a primipara in the last month of pregnancy, and, as the placenta was felt to be attached to the cervix uteri, it was thought desirable to bring on delivery. With this view, a sustained current was applied for three hours; the hæmorrhage was almost immediately arrested, and the labour had advanced so rapidly, that in a few hours afterwards it was completed by the birth of a living child. The author referred to other cases, in which he had successfully employed galvanism in obstetric practice; and, with reference to those related, submitted that they appeared to him to warrant the three following conclusions:—

"1. That a sustained current of electricity of moderate intensity, passed through the gravid uterus in the manner described, exercises a remarkble influence in increasing the tonicity and contractility of the uterine fibre.

"2. That in such increased tonicity or contractility of the uterine fibre, so excited and sustained, we have a powerful and reliable means of moderating and controlling uterine hæmorrhage, whether of the accidental or unavoidable variety, and of simultaneously accelerating the dilatation of the os uteri and the general progress of the labour.

"3. That such sustained current of electricity may be continued for a lengthened period, when the object to be attained requires it, without any appreciable pain or inconvenience to the mother or danger to the child.

"Sir C. Locock inquired whether the author had tried the

chains of Pulvermacher as a galvanic apparatus? because, if they were found to produce sufficient effect, they would be very advantageous from their portability. With respect to their power, he might mention that a few days since he had seen a chain of twenty-four links decompose water as readily as could be done by a common galvanic apparatus.

"Dr. Mackenzie had no experience of the apparatus of M. Pulvermacher. It had, however, been recommended to him; and the hint thrown out by the chairman might, no doubt, be beneficially acted upon.

"Dr. Tyler Smith believed that the author of the paper had selected the class of obstetric cases in which galvanism would be most likely to prove useful; namely, those in which the os uteri was closed, but where it was desirable to promote uterine contraction for the arrest of hæmorrhage. He could testify to the influence of galvanism in causing uterine contraction. He had some years ago induced parturition in the lower animals by its use. He had also employed it in cases of polypus, when the tumours were stuck up within the uterus; and had obtained the dilatation of the os uteri, and the expulsion of polypi into the vagina, by its means. In his experience, galvanism did not act instantaneously on being applied to the uterus, but required time for the development of its effects; and this was a misfortune, inasmuch as most of the exigencies of labour attended by hæmorrhage required immediate action. In such cases as those detailed by Dr. Mackenzie, in which abortion and labour were going on, it might certainly be objected that the same results would have followed if galvanism had not been used. He had, however, no doubt that the uterine action was really attributable to the galvanism. In the case of polypus, the influence of galvanism was unmistakeable; and uterine action could at any time be brought on when the uterus was previously in a perfectly quiet condition.

"Dr. Mackenzie said that his practice was the result of induction, and not of casual observation. By the performance of experiments upon the lower animals, he had arrived at

precisely the conclusions which were subsequently established in his practice at the bedside."

The apparatus to be employed is a most necessary consideration, which Dr. Mackenzie has, in his paper, failed to describe. The hint thrown out by the worthy president, Sir Charles Locock, was called for, as Dr. Mackenzie had neglected to recommend a battery. The one I use is that mentioned by Sir Charles; it being portable, easily applied, and producing a current of extreme energy without the painful calorific effects of the larger apparatus. M. Pulvermacher has, at my request, arranged an extremely ingenious apparatus, very portable, and will be found in such cases indispensable. The following cases are extracted from "The Provincial Medical and Surgical Journal," reported by Mr. Dorrington: they will serve to show the difference of action between the continuous galvanic current, as recommended by Dr. Mackenzie, and that of the electro-magnetic apparatus.

"The application of galvanism, recommended by Dr. Radford in the same lecture, in which he dilated on the separation of the placenta, is of far more extended service.

"The first case is one of internal hæmorrhage during labour. The patient had been previously attended by a midwife, and when Mr. Dorrington and Mr. Bent (both of whom were called in) arrived, they found her suffering from the effects of hæmorrhage in an extreme degree, though a pint of blood only had escaped externally. The labour pains had gone off; the os uteri was very rigid, and dilated to the size of half-a-crown only; and the uterus soft, and without tone, when examined through the abdominal parieties. About half a drachm of tincture of opium was exhibited, and a bandage applied. A thin serous discharge tinged with blood, however, continued to drain from the uterus, indicating internal hæmorrhage, and half a drachm of secale cornutum infused in water was therefore given in two doses, a little tea being added to the first, and a little brandy to the second. Before, however, this was done, Dr. Radford was sent for, and he was desired to bring his galvanic apparatus.

"In about twenty minutes or half an hour after the ergot

had been given, it began to act, and intervallic uterine contraction set in; the head bearing down on the os uteri, and the thin serous discharge soon after ceasing. In the intervals between the pains the uterus still remained soft and doughy.

"When Dr. Radford arrived he made a vaginal examination; raised the head from the os uteri, so as to allow of the escape of a considerable quantity of the liquor amnii, which had been retained above it, the latter portions of this fluid were deeply tinged with blood. He agreed with Mr. Bent and Mr. Dorrington in the opinion that to deliver in such a case would be death, even if the os uteri had been in such a state as to have permitted the proceeding. It was, therefore, determined to try Dr. Radford's new plan of galvanism, applied to the uterus, to induce tonic contraction of that organ, so as to keep the flooding in check, and give time to give support. One conductor of the electro-magnetic apparatus was applied to the os uteri, and the other to the abdominal parieties over the fundus uteri. The woman immediately began to complain that they were cutting her, and the uterine action came on at once. The instrument was used at intervals for twenty minutes; the result being so firm a state of tonic contraction, that it was considered safe to leave the patient. Stimuli and nourishment were administered, and the abdominal bandage applied. Six hours and a half afterwards labour came on, and a dead child was ultimately born, with the assistance of the accoucheur. The placenta was easily withdrawn from the uterus immediately after the birth of the child, and a coagulum about a pound in weight accompanied it. Another coagulum, weighing two pounds, was afterwards expelled. The patient was much exhausted. On the second day abdominal pain and tenderness, with tympanitis, supervened, which was not relieved by the treatment adopted, and she died on the fourth.

"Mr. Dorrington observes, respecting this case, that though the termination was unfortunate, yet it was a most satisfactory case as regards the application of galvanism. He draws a comparison between the relative influence of secale cornutum

and galvanism. The uterine action brought on by the former did not occur till an interval of from twenty minutes to half an hour after the administration of the drug; whereas that induced by the galvanism was instantaneous. The contractions from ergot were not nearly so strong as those from the galvanism; and the uterus, in the interval between the pains, before the application of the galvanic currents, remained soft and doughy; to which, he says, their attention was particularly directed by Dr. Radford at the time, as showing that the ergot had failed to establish that state of permanent tone in the organ which was the only security against further hæmorrhage. The galvanism, moreover, acted as a general stimulant, which was very useful in the depressed state of the patient; and in this respect its superiority over the ergot which, by some good obstetricians, is considered rather depressing, was very decided. The employment of transfusion after the application of galvanism, might, he thinks, have saved the patient's life."

The second case is one of accidental hæmorrhage before labour, occurring in a woman who had been pregnant eight times, and had had two miscarriages.

"In this case Mr. Dorrington applied the galvanic shocks and currents in both the longitudinal and transverse axes of the uterus. The effect on the uterine fibre was most marked; the firmest tonic contraction occurred the moment the organ was stimulated, and when the conductors were finally removed, a good tonic state of the organ existed; a fact which was proved both by its hardness to the touch, when examined through the abdominal walls, and by the head being in firm opposition with the internal surface of the os uteri. The constitutional effect upon the woman was very serviceable, for it acted as a general stimulus. Labour came on nineteen hours afterwards, and in two hours and a half a living male child was born."

These are not brought forward as cases to be followed, but as a contrast to the preceeding. Galvanism is a term which has been used in a very wide sense, whereas it really is the continuous current in contradistinction to the electro-

magnetic. In another case reported in the same journal Mr. Dorrington remarks :—"It answered perfectly, but he would not have recourse to it until he had tried milder measures, because it is unquestionably very disagreeable and painful to the patient." Eventually, Mr. Dorrington abandoned the use of the electro-magnetic apparatus, as not being adapted to obstetric practice, and, except in a few most exceptional cases, I quite agree with him. The danger to be feared is the production of a state of tonic spasm of the uterus, instead of the natural slow contraction and relaxation, induced by the stimulus of the continuous galvanic current. In uterine hæmorrhage, where death is imminent, the electro-magnetic current is indicated.

In concluding this portion of my work, I would earnestly beg those who have opportunities of trying the galvanic current in such instances, to apply it in those cases recommended by Dr. Mackenzie ; and if the rules here laid down are carried out, success must follow, as galvanism, unlike medicine, can be applied externally, and the effects produced immediately observed by the operator, an over dose cannot be given, and no accident can occur.

### Paralysis of the Bladder.

This organ is under the control of the ganglionic system, and therefore better adapted for the application of the continuous galvanic current than the electro-magnetic, although both have been used with remarkable success.

The following letter is from Mr. Simon (Surgeon to St. Thomas's Hospital), who has kindly allowed me to publish it :—

"In 1852, I used galvanism to the spermatic cord of a young man, aged nineteen, who was suffering considerable inconvenience from varicocele on the left side ; his recovery was very rapid and (as I have since heard) continued permanent. From that time onward, I have often used galvanism in similar cases, and also to varices in other parts (chiefly the lower extremity) when the dilatations or contortion of the vein has been unattended with inflammatory thickening.

In January, 1857, a boy, aged sixteen years, came under my treatment, who from birth had had incontinence of urine, complete by night and almost complete by day—general health good, urine of ordinary quality. The use of galvanism was begun on January 10, a silver catheter joined to one wire was passed to the neck of the bladder, while the other was applied to the anus, so as to direct a current (which was continued for fifteen minutes) through the prostate."

*Note.*—The instrument which I use for this purpose is preferable to the catheter, the terminal inch only being silver, a central iron wire as a conductor, covered with gum elastic, constituting the remaining portion of the staff; the consequence being that the galvanism is not expended in the urethra as is the case with the catheter, but is conducted direct to the prostate. The same description of instrument is required for the os uteri.—(H. L.)

"An immediate result was obtained as seen below.

"January 13th.—Has held his water both day and night since the 10th—Repeat galvanism.

"January 15th and 17th.—Has held his water both day and night since the 10th—Repeat galvanism.

"January 21st.—Has wetted bed twice since 17th—Repeat galvanism.

"January 30th.—Has wetted bed twice since 21st—Repeat galvanism.

"February 2nd.—Has wetted bed once since 30th—Repeat galvanism.

"February 4th.—No wetting—Repeat galvanism.

"February 6th.—No wetting—Repeat galvanism.

"Galvanism was used twice a week to the end of the month, when he was discharged cured. It will be observed that during some time he was irregular in attendance.

"In October, 1857, a child, aged three years, whom I had successfully cut for stone three months before, came again under my care on account of prolapsus ani. This had come on during the child's former very great suffering with stone, and then had been entirely neglected, so that the gut would remain constantly protruded to the length of two or three

inches. Recently various astringent and mechanical means had been unsuccessfully employed, and the gut, after being returned by hand, used for the most part to descend again directly.

"October 19th.—A weak current of galvanism was passed through the protruded bowel and the sphincter ani, the bowel having then been returned did not as usual descend again at once, but remained in place till the next action of the bowels, twenty-four hours afterwards, when the same treatment was repeated.

"October 28th.—Since the 20th there has been no return of the prolapsus, the galvanism, however, was still applied daily to the sphincter; once, about ten days afterwards, some protrusion took place, but the bowel was immediately reduced, and was not again seen during another week that the patient remained in the hospital.

"N.B.—It is essential, as regards the use of galvanism for incontinence of urine, to distinguish cases of *muscular inaction in the sphincter of the bladder* (for which alone this remedy is applicable) from cases of *irritable bladder* and cases of *acrid urine.*"

The following case of paralysis of the bladder is interesting from the rapidity and simplicity of cure :—

"A woman, fifty-seven years of age, labouring under an incurable disease, endeavoured to commit suicide by means of charcoal fumes. She was relieved in time, but an obstinate paralysis of the bladder remained. M. Monod suggested a trial of galvanism to the neck and fundus of the bladder. On the first application the patient was enabled to make water without assistance, and her recovery was rapid."

The cases next quoted may be found in the "Medical Times," twenty-first volume.

"I have of late employed galvanism with the best effects in a case of paralysis of the bladder, arising from over-distension. The patient, aged 70, was admitted into Hospital with retention of urine, of some days standing; and having ascertained that there was no enlargement of the prostate, or

other mechanical cause existing to produce the disease, I at once commenced the galvanic treatment, introducing one wire, by means of the catheter, into the bladder, while the other was applied along the sacrum, subjecting him to its use thrice a week, for twenty minutes each day. Suffice it to say, without going into unnecessary details, its good effects soon became evident by his regaining the power, at first, of passing water to a small extent only; when there was much urine in the bladder, of completely emptying the bladder; and left the hospital quite well, after thirty-five days' residence.

"I have also applied this remedy in prolapsus ani. As those cases arise from a relaxed or paralysed sphincter, it seemed to me to be reasonable to expect benefit from its use. I received a boy, aged 14, of delicate constitution, into hospital, who had been labouring under this disease for four years. On his admission, the rectum was protruded several inches, and so great was the relaxation of the sphincter that he, speaking from experience, said it would all go up as soon as he got warm in bed, which proved to be fact. The galvanic treatment was commenced by placing one wire, with a small ball, in the rectum, and applying the second along the sacrum, for twenty minutes every third day. After the fourth application the rectum ceased to protrude, and the boy left the hospital quite cured."

There is a striking resemblance to those cases treated by Mr. Simon, in St. Thomas's Hospital, with like success.

The following will be found interesting, from the length of time the malady had resisted all treatment, and the rapidity with which it yielded to galvanism:—

*Case* 28.—E. M. aged 39, had for many years found great difficulty in passing water. He had been accustomed to stand always for five minutes, frequently much longer, before any would appear; it was then a considerable time in passing. There was no stricture. Upon examination, I found a flaccid condition of the abdominal muscles: they were flabby and wasted. I applied the current of the electro-magnetic apparatus to the affected muscles with rapid recovery. He stated,

upon questioning, that he had suffered some years previously with severe rheumatic pains in the lower portion of the stomach, since which he had never, until now, recovered the healthy tone of those muscles; no treatment had ever been of the slightest benefit to him. Doubtless the muscular coat of the bladder was affected with the abdominal muscles.

### Paralysis and Chronic Catarrhal Inflammation of the Bladder.

M. Pétrequin, of Lyons, has communicated a paper to the Académie des Sciences, Paris, upon this interesting subject, in which he recommends the application of electricity as far preferable to all other forms of treatment.

"M. Pétrequin introduced into the urethra, without emptying the bladder, an india-rubber catheter with a large iron terminal, and into the rectum a thick bent metallic rod. One of the poles was successively brought into contact with the catheter and the rod in the rectum, while the other conductor, by means of a moistened sponge, was brought into contact with the hypogastric region, without touching either the inguinal folds, or the walls of the iliac fossæ. The electrization, from Duchenne's apparatus, lasted twenty-five minutes; the patient felt no pain, but no appreciable effect was produced on the disease. In the evening, the operation was renewed for twenty minutes, the patient evincing more sensibility. The following night, two or three spontaneous emissions of urine took place. The treatment was persevered in, and after a fifth very painful electrization, lasting ten minutes, micturition was voluntarily and regularly effected."

This case, although the means used was somewhat clumsy, is still very instructive, and well worthy of record.

### *Cases by* Dr. Joseph Bullar, *Southampton.*

We are in the habit of using galvanism in the South Hants Infirmary very frequently, for loss of nervous power, and for obstinate neuralgias, especially those which depend on a rheumatic state of the system. I find that, if galvanism is of

service, the patients become aware immediately of the improvement at the time; and if it does not suit, they feel immediately that it does them harm.

The most striking instance of its use which I remember, was in the case of a young man with paraplegia from acute curvature of his spine. I will copy the notes from a clinical lecture I gave on his case.

Henry L——, æt. 30, was affected, two years ago, with pain and stiffness in his dorsal vertebræ, so that in the morning he could not at first sit upright. He was a little better and a little worse for twelve months, when his legs began to grow weak. If he jarred himself by stepping down a step, or on a stone, it gave him great pain in his back, and his legs gradually became so weak in walking, that he was obliged to give up his work as a gardener, as he could not stand. He took to bed soon after. He had felt from the first a little tenderness and swelling about the seventh or eighth dorsal vertebra, and when he took to his bed there was an acute curvature, with no power of sensation or motion in both legs. On admission, on February 16th, 1858, there was acute curvature at the seventh and eighth dorsal vertebræ. He could not stand, nor move his legs in bed, nor feel from his knees downwards, but there was much twitching of his legs from spasmodic contraction of the muscles from reflex action. At first he knew this, but latterly he did not, unless he saw them, although his legs were so drawn up that his heels touched his thighs. There was difficulty in micturition, and his stools were passed involuntarily.

Two caustic issues were made, one on each side of the acute curve, and he took cod-liver oil, iron and strychnine, with a liberal diet. In two months he had so far improved as to feel that he could move his back better, and that it was stronger. Consolidation of the dorsal vertebræ was beginning, and in another month anchylosis was apparently completed; but there was no improvement in the legs. I then directed that he should be galvanized daily, with Faraday's electro-magnetic machine, one pole attached to each foot; and from this time his paralysis, both of motion and sensation, diminished, and

he was so conscious of improvement that he did not like the galvanism omitted for a day. Gradually, a very powerful interrupted current was used, and it was continued for an hour daily, and for some weeks. He then walked about the ward with one stick. He went into the country, and has returned to his work, and is able to take much walking exercise, and to be on his legs all day in a seedsman's shop. He continues well.

In this case the paraplegia depended on pressure upon the spinal cord, from the acute curvature of caries of the seventh and eighth dorsal vertebræ. Although the caries was so far cured that the bodies of the vertebræ became anchylosed, yet the spinal cord at the spot did not recover from the effects of the long-continued pressure until it was roused and stimulated by galvanism. There was no possibility of mistake in this case, for there was no improvement in the paralysis until galvanism was used; but from that time a steady improvement until the power and sensation of both legs were perfectly restored.

In a somewhat similar case, in which a man had become paralyzed in his fore-arm from sleeping on it, and therefore from pressure of the nerves, galvanism rapidly relieved him, although previous treatment had been of no service.

We use it in paralysis from lead, and it assists the other treatment. I asked a patient to-day, the extensor muscles of whose arms are paralyzed by lead, if he was convinced that the galvanism was useful; and he said he was. In cases of hemiplegia of some standing, I have seen galvanism assist in restoring the lost power; but I never recommend it in recent cases. When hemiplegia depends on a clot, and this has become partially absorbed, and the brain at the spot quiet, galvanism is indicated.

I have at present under my care two patients, in whom galvanism has been for the moment injurious. One was a vigorous lad of 19, who had been epileptic for years, and on whom galvanism, employed by a chemist and druggist, had produced so alarming a fit, that his life seemed at stake, and he was immediately sent into the infirmary. The other case is that of an elderly man, with paraplegia, loss of motion

of both legs without any loss of sensation, but with the most painful reflex contractions occurring in paroxysms. Galvanism had been tried in his case before he came under my care, with aggravation of the symptoms.

*Report of an* OBSTINATE CASE *of* AMENORRHŒA *successfully treated by the* APPLICATION *of* ELECTRICITY. *By* CHARLES TAYLOR, M.D., *Resident Physician to the Walton Lodge Asylum, Liverpool.*

A. B——, aged seventeen, single, was admitted July 3rd, 1858. She is a slight, delicate-looking girl, of middle height and sanguine temperament; the eyes are bright, pupils dilated, and she has a puzzled, anxious expression of countenance. There is nothing peculiar in the form of the head. The vascular and respiratory organs are healthy, and the functions of the abdominal viscera well performed. The face is covered with isolated pustules on a hardened base, which eruption has existed for some months, and, although yielding repeatedly to treatment, has always recurred. Pulse 100; tongue clean, and steadily protruded; skin cool; bowels regular. The hairy scalp is hot, and communicates a burning sensation to the hand.

The present, which is her first attack, and has been gradual in its accession, commenced about nine months ago, and was characterized in the onset by various peculiarities and eccentricities, which at length proceeded to such an extent as to necessitate her removal from home. She was then placed under the care of a lady in private lodgings in the country. Here she became violent, and personal restraint was rendered necessary on two occasions, for a single day each time; when, becoming altogether unmanageable, it was decided to place her in an asylum.

Her mental malady is marked by an ever-present feeling of distress at the neglect of some duty which she erroneously supposes incumbent upon her to perform. She is constantly proposing to do something far beyond her present powers, and, on failing, is thrown into a state approaching to anguish, which

is only relieved by a flood of tears. If thwarted, she screams, exhibits vagrant and violent action of the limbs, or even makes an attack upon some one in her immediate vicinity. The accompanying delusions are various: one, of a fearful character, refers to a book which she has lately been perusing; another induces her to believe that she will be compelled to work for six days and then rest for six; while a third leads her to press forcibly upon her abdomen with both hands for one hour each day. Slight prolapse of the rectum from which she suffers is probably due in some measure to this insane habit. The memory is good, and there is no defect of articulation nor unsteadiness of gait. She was always wilful and violent in temper, though of religious and strictly temperate habits, residing at home with her friends in the country, and pursuing an active and healthy mode of life. The head symptoms occurred simultaneously with disordered menstruation, and were apparently aggravated by total absence of the catamenia, which has, with two slight exceptions, existed, in spite of the most judicious and energetic treatment, up to the date of admission. Ordered, a quarter of a grain of acetate of morphia, with sufficient water to make a draught—to be taken thrice daily.

August 1st.—Is still very excitable, and suffers from a variety of delusions. Pulse 70, weak; skin cool; scalp very hot. Ordered citrate of iron and quinine, two scruples, with water sufficient to make an eight-ounce mixture—two tablespoonfuls three times a day; acetate of morphia, one grain every night; one tablespoonful of cod-liver oil, and a wine-glass of port, twice daily; liberal diet; a shower-bath each morning, and ice to the head for two hours night and morning.

August 25th.—Is slightly improved in general health, but continues very confused and incoherent, and is still afflicted with numerous delusions. To have bicarbonate of soda, half a drachm; decoction of aloes and powdered capsicum, of each one scruple; oil of savine, sufficient quantity to form into eighteen pills: two to be taken three times a day, with a full dose of the etherial tincture of ergot. A hot hip-bath to be substituted for the shower-bath the last week in each month

(that being the presumed menstrual period). To continue the tonics and liberal diet, and to take much exercise.

September 25th.—Health decidedly improved, and mental condition ameliorated. The menses have not yet appeared. To have large cupping-glasses applied to the inner surface of the thighs each night of the last ten days of the month; a hip-bath, with mustard, as hot as can possibly be borne, to be used each night during the same period; also a teaspoonful of the following mixture thrice daily, with five minims of the oil of savine and an occasional aloetic aperient:—Tincture of cantharides, muriated tincture of iron, and ethereal tincture of ergot of rye, P. E. In the intervals, this mixture to be substituted for the quinine and iron:—Phosphate of iron, one drachm; dilute phosphoric acid, two drachms; water to eight ounces: two tablespoonfuls three times a day.

October 25th.—The general health continues to improve. Menses still absent. The emmenagogue treatment to be continued through the latter half of each month, in addition to the baths, &c.; and to wear a 60-link Pulvermacher chain, the positive pole on the sacrum, the negative on the groin, with interrupter, for one quarter of an hour night and morning.

November 25th.—Much the same; menses still absent. Two chains of 30 links, each with continuous current—one pole upon the abdomen, the other upon the groin—to be worn two hours night and morning. Hot hip-bath, warm clothing, warm drinks on retiring, exercise, and other emmenagogue treatment to be continued; and, in addition, a pungent solution of strong liquor of ammonia in milk to be injected per vaginam night and morning.

November 30th.—The chains have produced slight sores, and are irksome. To be discontinued.

December 2nd.—An interrupted current to be applied to the os uteri night and morning, the positive pole being placed over the sacrum; a 30-link chain to be employed, and the links wetted one by one. All other treatment and remedial measures to be discontinued.

December 6th.—The chain has been applied, with all the

links excited. No effect was produced, and no sensation experienced. A 60-link to be substituted, and used night and morning for two days. Much smarting was experienced in the situation of the sacral pole.

December 9th.—Menses appeared this evening; colour natural.

December 14th.—Menstrual flow continued until this date.

December 25th.—General health and mental condition have much improved since last report.

June 10th, 1859.—Since last entry, during a period of six months, the patient has menstruated regularly every fourth week. The reappearance of the catamenia was accompanied with considerable improvement in the mental condition, and for some time past she has been sufficiently restored to attend concerts, the theatre, and other public meetings. Occasional fits of excitement somewhat interrupted the progress of the case, but she is now, although not perfectly recovered, and still subject to occasional eccentric outbreaks, well enough to live with the family, converse rationally, and associate with strangers, who do not detect anything abnormal. The pustular eruption, formerly a source of much anxiety, gradually faded, and the face has been for some months quite free from blemish.

On July 22nd the patient was sufficiently recovered to return home, and on the 15th of August I received a very favourable account of her health and conduct from her friends.

In recording the preceding case, my object is not so much to call attention to a valuable, though frequently-neglected therapeutic agent, as to suggest to my professional brethren the adoption of that mode of applying the galvanic current which I found efficacious, and which I believe to possess some advantages over the methods commonly employed. The introduction of an isolated conductor into the os uteri, and the use of an ordinary electric machine, necessitate the presence of the medical man, and involve the exposure of the patient. Being particularly anxious to avoid the latter, I was induced, in the present instance, to use as one electrode a wooden

female syringe, perforated with copper wire, and protected by a small piece of wet sponge. The patient having been accustomed to the injection of fluids, this instrument was readily introduced, and by merely attaching one pole of Pulvermacher's chain to the end of the wire, while the other was applied to the sacrum by an elastic band tied round the abdomen, a powerful current was passed at once through the uterus. Common household vinegar is sufficient to excite the chain; no initiation is required; and any patient may thus, in the privacy of her own chamber, as easily direct a current through the womb as inject a stream into the vagina.

In the conduct of the foregoing case I was unnecessarily cautious, as a high power is readily borne. The effect with some patients is immediate, and although that was not the case with mine, I cannot but conclude that galvanization roused the atonic uterus when almost all the usual therapeutic means, carefully applied, had failed.

An eminent physician, who formerly had charge of the patient, states that he had administered all the usual internal remedies, with the effect only of producing a slight and transient flow of the menses on the two occasions already referred to. He was about to use galvanic pessaries, when her mental state compelled him to suggest removal to an asylum. As the friends also consulted other gentlemen well known in the medical world, it is but just to admit that ordinary means had proved ineffectual, even prior to the energetic measures unsuccessfully adopted under my own immediate superintendence.

*Report of a* CASE *of* PARAPLEGIA, *successfully treated by* LOCALISED ELECTRICITY, *by* CHAS. TAYLOR, M.D., *Resident Physician, Walton Lodge Asylum, near Liverpool.*

H. M. æt. 18, single gentleman,

Through the kindness of an eminent physician in this town, came under my care, to be treated for an attack of paraplegia, on the 27th of August, 1859.

Is a fresh-looking, well-developed young man, of sanguine temperament. The vascular and respiratory organs appear healthy, and the functions of the abdominal viscera are well performed. Pulse 80, regular; skin cool; tongue furred, moist, steadily protruded; no defect of articulation.

For some time past has been complaining of gradually increasing debility of the lower limbs; and for at least a month they have been utterly useless as organs of locomotion. He is quite unable to stand, and moves from one apartment to another by the aid of a pair of crutches. If he attempts to rise from a sitting posture, by grasping a chair or table, he falls back quite helpless. If supported on one side, the legs double up, the knees knocking together, and, if not prevented, he would sink to the ground. Has no pain in the back, and no tenderness is felt on percussion along the spine. Sleep natural, not troubled with dreams or involuntary startings. Senses and sensibility normal; no evidence of saturnine poisoning, worms, or rheumatic affection. The functions of the bladder and rectum are normal, and the superior extremities unaffected. Has been taking 11 grains of sulphate of zinc per diem.

Five years ago he suffered from a similar attack, when the late Dr. R. Bright prescribed sulphate of zinc, which he took in doses of 10 grains, thrice daily. After persisting for six months the paraplegia gradually yielded, and he appeared to regain full power over the affected limbs. Two sisters are afflicted much in the same way, to a greater degree, one having been confined almost constantly in the recumbent posture for 11 years.

August 27, 1859.—A gentle to and fro galvanic current was passed from the lumbar region to the feet, and electricity localized in each of the affected muscles for one or two minutes.

August 30th.—Complained of lassitude after the last *séance*, but expresses himself now as slightly improved.—Repeat operation, electricity localised.

September 1st.—Was able to put down his crutches and walk across the room to meet me to-day; states that since the

last operation, has put his foot in the stirrup and mounted a horse unassisted.—Repeat electricity as before.

September 3d.—Owing to indisposition I was unable to attend to-day, according to appointment, but received a note from his mother, stating that the crutches were quite discarded, and that he was so well as scarcely to need further help.

September 4th.—H. M. attended church to-day, walking there and back, about a quarter of a mile, and standing during service.

September 5th.—Can walk steadily at a good pace; expresses himself as quite recovered.—Repeat electricity.

September 7th.—States that he can run and jump as well as anybody; appears quite well; electricity repeated.—Cured.

*Remarks.*—The effect of the galvanic current in the foregoing case was marvellous, and to witness the delight with which the patient noticed the rapid and decided improvement was truly gratifying. Completely crippled himself, and with the melancholy spectacle before his eyes of two paralyzed sisters whose cases had resisted all treatment, no wonder that it was with but little faith that he resorted to galvanism as a *dernier espoir*. So slight was his hope of benefit, that had not the improvement been as rapid as it was marked, I feel that he could not have been induced to continue the application. The integrity of the electro-muscular contractility, and the absence of any decided indications of head affection (excluding the diagnosis of cerebral or spinal lesion) warranted a very sanguine prognosis, and thus enabled me to offer him sufficient inducement to commence the treatment.

The current passed from the lumbar region to the feet was merely a placebo, and I attribute the cure entirely to the localization of the electricity in each of the affected muscles.

*Report of a* CASE *of* CHOREA, *with loss of power of motion in lower limbs—considerably ameliorated by the* APPLICATION *of* ELECTRICITY. *By* CHARLES TAYLOR, M.D., *Walton Lodge, Liverpool.*

M. P——, æt. 10, female.—A feeble, emaciated child, of sanguine temperament; vascular and respiratory organs

normal; no disease of abdominal viscera. Skin cool, tongue clean, steadily protruded; no defect of articulation; intelligence and memory good. Commenced to walk at two years of age, but gait was always vacillating and unsteady, necessitating frequent support. When seven years old, had an attack of scarlet fever, since when she has suffered from chorea, the symptoms being aggravated by constant association with a brother similarly afflicted. She gradually got worse, and at present date (June 14th, 1859) is quite helpless, unable to stand, feed, or dress herself, the lower limbs being partially paralyzed, and incapable of supporting the body, while the upper extremities are thrown into violent and irregular action when stimulated by the will.

The treatment was commenced on the above date by passing, by means of wet excitors, an interrupted electro-magnetic current from the nape of the neck to the feet (to be repeated twice a week). Much pain was experienced, and but slight benefit resulted. At the end of three weeks I therefore substituted a direct current, and found a higher power was borne, and less pain occasioned under this treatment; continued with a few intermissions, and varied now and then by counter irritation with the wire brush up to present time. She speedily improved, and is now (September 4th, 1859) able to stand alone, walk two or three hundred yards unaided, thread a large needle, dress and feed herself. Is still under treatment.

*Remarks.*—In this case I was anxious to employ static electricity, extracting sparks from the spine, with occasional application of galvanism to the muscles of lower extremities, and I have no doubt this would have been the best method of treatment. The frictional machine, however, proved cumbrous and inconvenient, and I was induced to pass a current along the back, occasionally extracting sparks with the electric brush, as a substitute for the former mode of treatment, so successfully adopted in cases of chorea by Dr. Golding Bird.

## Aphonia.

I extract the following case from article 5514 of the "Journal of Practical Medicine and Surgery," from the method of applying the conductors being novel.

"A young lady, 21 years of age, had entirely lost her voice for a year from cold; resisting every form of treatment. Dr. Philipeaux was called in, and deemed it expedient to try electricity, which he applied in the usual manner eighteen times without success. He then inserted a conductor into the pharynx in order to act on the recurrent laryngeal nerve and on the muscles of the larynx; while the second conductor was placed outside on a level with the crico-thyroideus muscle. Scarcely had the electric current been established when the patient uttered a piercing cry, and was seized with a nervous fit, which lasted all the evening and part of the night. On awaking she recognized with joy that her voice was restored."

## Amaurosis.

The following are the conclusions arrived at by M. Finella in the treatment of loss of sight through want of nervous force to conduct the image reflected on the retina to the brain.

In three amaurotic patients submitted to the action of galvanism with much benefit, M. Finella states that the positive pole of the battery acted more efficaciously than the negative; and that however intense the current might be, the contact of this pole with the cornea produced no opacity or other alteration; neither did it cause headache, noise in the ears, nor vertigo. He also states that the more profuse the lachrymation which ensues on galvanism, the more favourable the effect of the remedy on the amaurosis. The

same favourable prognosis may be deduced from the perception of sparks by the patient. In fact, according to the author, these two signs united furnish the surgeon with the most certain means he can desire on which to rest his prognosis of the probable issue of the disorder.

M. Duchenne, of Boulogne, believes that the current of the secondary wire acts more powerfully upon the retina than that of the primary; and this is undoubtedly true: still neither of them has so intense an effect upon the nerves of vision as the continuous galvanic current. The direct current has a more powerful stimulant effect upon the optic nerve than the inverse. If the positive pole be placed upon the eyelid or brow, the negative upon the back of the neck, and a tolerably powerful current passed, a blue light will be perceived; but if the poles be reversed, an orange.

In amaurosis, if these different colours can be detected, hopes may be held out of benefit, or even a cure; but after several attempts have failed it is very little use continuing the treatment, there being evidently an organic injury which is insurmountable. If any benefit is derived from the passage of the current the treatment should be continued, and several times daily; for I find that in all nerves of special sense the stimulus is required more frequently than in the muscular system, as otherwise the effect is transient, and soon lost.

## Deafness.

Dr. Duchenne makes use of the following method of applying electro-magnetism in cases of deafness:—

"The patient's head being inclined, so as to place the external auditory duct in a perpendicular direction, a quantity of water, sufficient to fill the first half, is injected into the cavity, and a metallic wire is plunged into this liquid, avoiding its contact with the membrana tympani, or with the walls of the auditory duct. Contact, in fact, occasions acute pain

at the moment of the passage of the current, so an ivory sheath is adapted to the wire to prevent it. The circuit is closed by applying a moist conductor to the mastoid process."

The cases in which Dr. Duchenne has employed this method are those in which there is no organic lesion, commonly called nervous deafness.

## Painters' Colic.

M. Briquet, Physician to La Charité, Paris, has demonstrated, beyond a doubt, that the seat of this painful malady is in the muscular walls of the abdomen; and that it can be cured by electricity in a very few minutes. In article 5478 of the "Journal of Practical Medicine and Surgery" will be found M. Briquet's method of reasoning and treatment,—of which what follows is a short *résumé*.

"M. Briquet makes use of the apparatus of Legendre et Morin:—one pole, by means of a wet conductor, is placed upon the skin as near as possible to the seat of pain; the other pole, attached to the wire brush conductor, is moved over the whole surface of the painful part; this creates extreme pain, and the skin is rapidly reddened; and in from one to four minutes, painters' colic is completely removed. If the patient is unable to bear the pain of the electrization, M. Briquet is accustomed to first give chloroform: the result, however, is the same—the colic is removed. In twenty-four patients the cure was permanent; in eighteen more electrization was repeated twice or thrice. A short time after the pains had ceased the other concomitants of painters' colic soon disappeared. Appetite returned; the bowels were relieved without any of the patients requiring purgatives. On an average the patients left the hospital on the seventh day; but the majority might have been discharged much sooner."

## On the Electro-magnetic Current as a Revulsive in Minor Surgical Operations.

I do not consider it right to pass over in silence this subject, although I cannot say I have much faith in its efficacy; still I think it desirable to mention it. I extract from article 5593, "Journal of Practical Medicine and Surgery:"—

"To perform incisions M. Morel Lavallée first placed one of the conductors in the patient's hand, the other communicating with the bistoury: but later, having to opén an abscess, he contented himself with applying the two conductors to the extremities of the diameter of the tumour, and the incision was performed without the patient being conscious of any pain. Dr. Foussagrives, of Cherbourg, confirms this experiment, having operated in six cases by the same method without pain.

"M. Alphonse Amussat performed also a very serious operation of fistula in ano; and, thanks to the intervention of electricity, without pain. One conductor was kept in contact with the left buttock, and the other attached to the bistoury. The patient, an intelligent man, stated that he felt nought but a moderate heat, with a weak vibration, and a slight local numbness."

These experiments have been repeated at University Hospital, London; and, according to the journals, with tolerable success. The subject has not, however, been touched upon the last few months: it is probable, therefore, that the plan is not altogether applicable to surgical practice. It is, however, well worth an extended trial and a good report.

## Ununited Fractures.

There are some cases of fracture which will not unite; it is true they are rare, still it is useful to be acquainted with an agent which will set up irritation about the fracture, termi-

nating in the production of bone. The following case will be found interesting:—

"Mr. J. Burman, of Wath, near Rotherham, relates, in 'The Provincial Journal,' the case of a man, 35 years of age, a teetotaller, of robust constitution, who received a fracture of the leg by being thrown from his gig. The surgeon who attended him put the limb in a good position, and everything appeared to go on well, till on the removal of the splints it was found no union had taken place. Fourteen weeks after, when he came under the care of Mr. Burman, there was found a transverse ununited fracture of the lower third of both tibia and fibula; there was no formation of callus, and the fractured ends of the bones were quite movable, but could be readily adapted to each other; neither was there any inflammatory action about the parts, although, having been advised to rub the two ends of the bones together, he had very assiduously followed that advice. He was ordered a kind of boot made of sheet iron, which, when applied, might embrace the whole leg, ankle, and foot. This was well adapted to the limb by means of padding, so as to prevent any lateral motion—an object which was the more readily accomplished as the fracture was transverse; and that part of the boot which was over the fracture was made to turn back upon a hinge, so that at any time the injured part could be reached without disturbing the limb. With this apparatus firmly fixed, he was directed to take daily exercise in the open air; to partake freely of wine, porter, and animal food, and, when sitting, to have the fractured ends firmly pressed against each other, by means of a broad band passed over the knee and under the footboard, capable of being tightened by a strap and buckle, the leg being bent at the same time at a right angle with the thigh. In addition to this, for nearly half an hour every day, an electro-magnetic current was made to pass directly through the fracture by means of needles attached to the two poles of the apparatus, their points being inserted just under the skin, on each side of the fracture. This plan of treatment was commenced on the 9th of October; by the 22d, sufficient inflammatory action had been set up to render the further

application of galvanism unnecessary ; and by the 30th, the deposit of callus was so copious, and the union of the fracture so firm, that the patient was permitted to return to his duties. The electro-magnetic apparatus used was a double-coil machine, two needles connected with this being introduced obliquely just under the skin on each side of the fracture, thereby causing the galvanic current to pass directly between the ends of the fractured bone ; and an acute pain was experienced when the circuit was just completed, but in a minute or two the pain became bearable, and the patient was able to sit under it for from fifteen minutes to half an hour."

# INDEX.

THE END.

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